

## MASTER

### Modelling the innovator's adoption decision a case study at new technology ventures

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Modelling the innovator's adoption  
decision: a case study at new  
technology ventures

by

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in partial fulfilment of the requirements for the degree of

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## **Abstract**

This report describes the development of an adoption model for radical innovations launched by new technology ventures (NTVs). These ventures have high failure rates and marketing is found to be a major hurdle to success. The model that is developed describes a set of information sources that potential adopters consult in order to make an evaluation of the innovation and its recently established supplier. The basis of the model is derived from a literature review and is extended and underpinned by the findings from eight case studies that have been conducted at new technology ventures in the Netherlands. The main insight is the specific influences that a set of five specific information sources on the adoption decision thus an understanding of the preferences and behavior of the target market. These insights have value for both theory and practice as they provide a novel perspective on the adoption of radical innovations commercialized by NTVs.

## Acknowledgements

This thesis is the result of my dissertation research project for master program Innovation Management at the Eindhoven University of Technology (TU/e) which I performed between January and December 2012. The project was supervised by the ITEM (Innovation, Technology, Entrepreneurship and Marketing) department at the faculty of Industrial Engineering & Innovations Sciences (IE & IS).

The fast-moving and risky environment in which new technology ventures are active and my interest in innovation and marketing motivated me for this topic. The research design did not allow for a graduation internship as the intention was to involve several ventures in this research which made it a both a challenging as well as a very individual assignment. Though this project would not have been successful without the support of others and hereby I would like to thank a few of these people.

Firstly I would like to thank my first supervisor Joost Wouters for his support. His critical view and the discussions we had were of great value for the successful completion of this project. Additionally Mr. Wouters referred me to a fellow student who had access to the sample for this research which wouldn't have been possible without his help. Furthermore I would like to thank my second supervisor Isabelle Reymen for her useful comments on my work.

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Bart van den Heuvel

Tilburg, december 2012

## Executive Summary

### Introduction

The purpose of this thesis is to offer a contribution to the knowledge on the adoption and diffusion of innovations. The specific focus lies on radical innovations that are brought to the marketplace by new technology ventures (NTVs) that commercialize a new technology that was developed at a (large) corporation or university. NTVs are drivers of economic growth due to their innovative and high tech nature. Although there are very successful examples of NTVs, many of them fail (Aspelunda, Berg-Utbya, & Skjevdaal, 2005). Marketing is found to be a major hurdle to success but marketing research has so far overlooked the context of these entrepreneurial organizations (Miles & Darroch, 2006). Marketing awareness and research are commonly limited to interaction between the firm and market while understanding the preferences and behavior of the target market is a critical component of marketing (Moore, 2006) (Banyte & Salickaite, 2008). This research aims at closing this gap of knowledge by developing a model of the adoption decision of innovator-customers buying from an NTV. The basis for the conceptual framework is Rogers' (2003) model for the diffusion of innovations which is extended and modified to fit the radical innovation -and NTV context. The adoption decision is in general characterized by high uncertainty regarding the technology and its newly founded supplier and therefore potential adopters will search for information to reduce this uncertainty.

### Research objective

The objective of this research is to answer the following main research question:

**How do innovator customers evaluate a radical innovation diffused by a new technology venture?**

To answer this research question a total of three research assignments will have to be carried out.

**Assignment 1:**

Develop a theoretical conceptual framework that models the adoption decision by innovator customers adopting a radical innovation from an NTV.

**Assignment 2:**

Underpin and extend the conceptual framework by analyzing the NTV-customer interaction in the early stages of commercialization.

**Assignment 3:**

Integrate the findings of both assignment 1 and 2 in a conceptual framework, modeling the innovator's adoption decision.

### Research methodology

The first assignment is carried out by performing a literature review. A snowballing literature search strategy was used initially based on a conceptual paper on this topic. Additional literature was found using the Google Scholar and ABI/inform search engines, the search was done with

the following base keywords: “innovation diffusion”, “high tech marketing”, “SME marketing”, “spin off marketing” and “spin off networking”.

The second assignment is carried out by performing a total of eight case studies at NTVs with a focus on the interaction with their potential adopters. Because of the lack of studies in this particular context a case study approach is suitable for gaining information and theory building on this topic. Guided by a theoretical framework to achieve a good focus, case studies are posed to be suitable for theory building on relatively new topics, describing a situation into detail (Eisenhardt, 1989). The within-case analysis serves as a description of the findings within a single setting and subsequently the cross-case analysis investigates the similarities and differences between the cases and hence tests the applicability of the theoretical framework across all cases.

## Findings

The theoretical framework that is developed was found to capture the phenomenon being researched accurately though it was extended and modified by the findings of the case studies to increase its accuracy. The adjustments to Roger’s (2003) model were supported by the case studies. The addition of the NTV’s liability of newness found strong support in the case studies. Furthermore the addition of information sources by drawing on information seeking theory was supported by the findings. Adopters consult a variety of sources to seek for information that can reduce their uncertainty regarding the innovation and the NTV. The resulting framework incorporates the following information sources: *reference customers, opinion leaders, founding team, advisory board & partnerships*.

## Conclusions

This research project is of value for both theory and practice. As the current literature lacks a conceptual framework for the adoption decision of innovator customers buying from an NTV this explorative research is to be regarded as a first effort to close this gap of knowledge. From a managerial point of view the findings of this research project will be useful for the executives of NTVs as it provides insights in the adoption decision of their customers. These insights in the potential adopter’s decision process can be used in the venture’s marketing efforts to increase commercial success.

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# 1 Introduction

## 1.1 Theoretical background

New Technology ventures (NTVs) are viewed as a driving force behind the future growth of any economy as they are innovative and high technology organizations (Bhide, 1994) though many of them have not been very successful (Aspelunda, Berg-Utbya, & Skjevdalb, 2005) (Nerkar & Shane, 2003). Marketing is found to be a major hurdle to success and can be used by these firms as a competitive advantage (Banyte & Salickaite, 2008) (Storey & Tether, 1998). Marketing research has so far overlooked the context of these entrepreneurial organizations that are characterized by limited capabilities, resource constraints and differing business objectives (Miles & Darroch, 2006). Market awareness and research are mostly limited to interaction between the entrepreneur(s) and market while understanding the preferences and behavior of the target market is a critical component of marketing (Moore, 2006) (Banyte & Salickaite, 2008). This research covers business-to-business marketing, which is different from business to customer marketing as consumers are mainly seeking for the satisfaction of an individual need while businesses adopt to sustain and achieve competitive advantages (Chisnall, 1989). The radical innovativeness of an NTV's products and services does not ensure commercial success because this causes potential adopters to evaluate them full of perceived and cognitive risks (Lee & O'Connor, 2003). This adoption decision is not only characterized by high uncertainty regarding the new technology as well as the NTV's liability of newness. The fact that the NTV has been able to attract funding and a reference customer are the few indicators potential adopters have to prove the value of the innovation and the NTV's chance to survive.

## 1.2 Problem statement

Many NTV failures can be ascribed to poor understanding and management of the process of diffusion and adoption of its radical innovation. The current body of literature lacks a conceptual model that describes the innovator-customer's adoption decision whilst this increased understanding is useful for NTV executives and a valuable contribution to theory.

1. The term 'innovator customer' or simply 'innovator' is used to refer to both innovators and early adopters (Rogers, 2003). Throughout this research paper 'adopter' or 'customer' are used as synonyms for this term.

### 1.3 Research objective

The objective of this research is to answer the following main research question:

**How do innovator customers evaluate a radical innovation diffused by a new technology venture?**

To answer this research question a total of three research assignments will have to be carried out.

**Assignment 1:**

Develop a theoretical conceptual framework that models the adoption decision by innovator customers adopting a radical innovation from an NTV.

**Assignment 2:**

Underpin and extend the conceptual framework by analyzing the NTV-customer interaction in the early stages of commercialization.

**Assignment 3:**

Integrate the findings of both assignment 1 and 2 in a conceptual framework, modeling the innovator's adoption decision.

### 1.4 Research design

The first assignment is carried out by performing a literature review. A snowballing literature search strategy was used initially based on a conceptual paper on this topic (Wouters & Nijssen, 2010). Snowballing does secure the quality of the literature to some extent but additionally these articles have been checked for the number of citations and quality of the journal by checking if the journals were included in the journal quality list of the Eindhoven University of technology library. Additional literature was found using the Google Scholar and ABI/inform search engines. The search was performed with the following base keywords: "innovation diffusion", "high tech marketing", "SME marketing", "spin off marketing" and "spin off networking". To secure the quality of the literature found by these search engines a minimum of 15 citations was maintained. The only exception to these norms was literature of the last 5 years for which 10 citations was required.

The second assignment is carried out by performing case studies at NTVs with a focus on the interaction with their (potential) customers. Because of the lack of studies on this particular context a case study approach is suitable for gaining insights and theory building on this topic. Guided by a theoretical framework to achieve a good focus, case studies are posed to be suitable for theory building on relative new topics, describing a situation into detail (Eisenhardt, 1989). The within-case analysis serves as a description of the findings within a single setting and subsequently the cross-case analysis investigates the similarities and differences between the within-case analyses. Finally the third research assignment is carried out by comparing the

findings of the cross-case analysis with the theoretical framework. These findings are aggregated into a final conceptual framework.

### **1.5 Thesis outline**

This thesis sets off with the development of a theoretical framework in chapter 2. This is followed by the within case analysis in chapter 3. This chapter starts with a description of the used methodology and hereafter the findings per case are described. Chapter 4 describes the findings of the cross-case analysis and entails the models that have been developed as a result of this analysis. The 5<sup>th</sup> and final chapter contains a discussion of the findings of the study that are integrated into a final conceptual framework. This is followed by the theoretical and managerial implications of the findings. This chapter closes with limitations of the research project and directions for further research.

## 2 Theoretical framework

### 2.1 Introduction

This chapter describes the literature review of the innovator-customer's adoption decision. More specifically this entails the adoption of a radical innovation diffused by an NTV. Firstly the topic is introduced by describing the NTV and the challenge these ventures face in bringing their radical innovation to the market (§2.2). Next the early stages of commercialization are described leading to the gap of knowledge on the adoption decision that this review aims to close (§2.3). Additionally, based on the work of Wouters and Nijssen (2010), a conceptual framework is constructed (§2.4 & § 2.6) and extended by additional literature (§2.7-§2.9). The result of this chapter is a theoretical framework (§2.10) that serves as the basis for the second and third research assignments. The research assignment that is carried out in this chapter is:

#### **Assignment 1:**

Develop a theoretical conceptual framework that models the adoption decision by innovator customers adopting a radical innovation from an NTV.

### 2.2 New technology ventures: drivers of economic growth

In modern economies entrepreneurship is more vital for economic growth than ever (Wennekers & Thurik, 1999). One form of entrepreneurship is the transfer of research results by universities and corporations by means of setting up ventures. These ventures are generally called *spin-out* or *spin-off*. When the product that is brought to the market incorporates a substantially new core technology the venture is a *new technology venture* (NTV). These products are radical innovations which provide substantially higher customer benefits over current alternatives (Chandy & Tellis, 1998). A study performed by BankBoston (1997) found 4000 NTVs originating at the Massachusetts Institute of Technology that provided jobs for 1.1 million people and with annual global sales totaling 232 billion, which is equal to the 24<sup>th</sup> largest national economy in the world. NTVs are viewed as a driving force behind the future growth of any economy as they are innovative and high technology organizations (Bhide, 1994). For example in Europe where in the 1980's the computing and technical service sectors grew rapidly in terms of employment as in the number of organizations due to small and micro firms (Storey & Tether, 1998). NTVs are generally considered high risk ventures which are not likely to survive though research on NTVs in Europe provides mixed evidence to support this claim (Storey & Tether, 1998). Nerkar and Shane (2003) found that even though there are striking success stories of this kind of ventures many of them have not been very successful. Other research found that the probability of survival is limited for new ventures in general but in particular for technology based ventures (Aspelunda, Berg-Utbya, & Skjvedalb, 2005).

There are numerous factors that affect the probability of survival of a venture, but marketing is found to be a major constraint as well in the start-up as in later phases (Storey & Tether, 1998) (Banyte & Salickaite, 2008). To be able to provide customers value understanding their preferences is highly important (Hills, Hultman, & Miles, 2008). Market awareness and research in NTVs is commonly limited to interaction between the firm and market while understanding the

preferences and behavior of the target market is a critical component of marketing (Moore, 2006) (Banyte & Salickaite, 2008).

### **2.3 Radical innovation diffusion**

Conventionally it has been argued that marketing planning and execution in Small and Medium Enterprises (SMEs) were hampered by hurdles such as a lack of financial resources, small firm size, absence of marketing expertise and the scant use of specialists (Huang & Brown, 1999). In contrast to these findings, recent contributions to the marketing and entrepreneurship literature argue that the inexistence of formal marketing strategies and planning within SMEs is not to be viewed as a lack of marketing in general. Instead SMEs employ different forms of marketing compared to more conventional and structured forms used by large organizations, and they require novel conceptual frameworks to be fully understood (Hills, Hultman, & Miles, 2008).

NTVs in general are active in high tech markets, markets that have economic and financial characteristics that are unattractive to established firms (Christenson & Bower, 1996). High tech markets are characterized by a rapid pace of technological change which makes the market technologically heterogeneous referring to the non-existence of a common technological standard as there are multiple, commonly differing, product standards and features (Tushman & Anderson, 1986). This makes high tech markets niche-markets, places where a deviation from the rules and norms of the existing regime is possible because potential adopter lack relevant prior experience with the innovations offered here (Von Hippel, 1986). This implies that adoption of radical innovations cannot be a passive act but requires adaption and learning from all parties involved (Geels, 2004).

As a first step the NTV will have to attract a first customer with whom they collaborate to finalize the innovation. Close interaction and cooperation with the right initial customer can improve this process, not only because the innovation is put to the test in practice but also by suggestions from the customer to improve it, alike lead users (Von Hippel, 1986). Commonly based on its network and heuristics the NTV will select the most interested and obvious party. The next challenge and step is to foster the further diffusion of the innovation in the marketplace. The leading theory on the diffusion and adoption of innovations is that of Rogers (2003) who defines innovation diffusion as “an innovation, which is communicated through certain channels, over time, among the members of a social system”. These members of a social system are the adopters of the innovation who will in theory adopt if the evaluation of the innovation has a positive outcome. This is dependent on the relative improvement over current alternatives, which is the balance between benefits (economic and social) and costs.

While the majority will rely on well-established references to make their adoption decision, innovators do not because they are developing new norms in the market and breaking existing patterns. Instead innovators rely more on their own vision and individual assessment of the innovation than on others. This decision process is characterized by high uncertainty regarding the new technology as well as the NTV's liability of newness. The fact that the NTV has been able to attract investors and a reference customer are the few indicators potential adopters have to prove the value of the innovation and the NTV's chance to survive. The first customer is used

as a reference to increase the legitimacy of the innovation to prospect adopters. Research has paid little attention to the business-to-business buying decision process that takes places in the early stages of market adoption. And furthermore how the group of adopters after the initial customer adopt hence this represents a gap in the literature. The need to adjust Rogers' model to the NTV-innovator context is argued by the suggestion of a "chasm before the chasm" (Wouters & Nijssen, 2010) referring to the chasm identified by Moore (2006).

## 2.4 The innovator's adoption decision

Rogers (2003) model encompasses a set of innovation characteristics on which potential adopters base their evaluation of the innovation. These are: relative advantage, compatibility, complexity, trialability and observability. This set is expanded to fit the radical innovation context by two additional innovation characteristics. Firstly uncertainty is added to as this is a dimension of radical innovation (Green, Gavin, & Aiman-Smith, 1995). Secondly switching costs is added, these are costs that result from commitments to the current technology (Heide & Weiss, 1995). Due to prior purchases organizations may have invested in assets that are not compatible with the new technology. This leads to a total of seven innovation characteristics which are listed and defined in table 1.

Innovation characteristic	Definition
Relative advantage	Relative advantage of product over existing alternatives
Compatibility	Consistency with the existing values past experiences and needs
Complexity	Difficulty to understand and use
Trialability	The extent to which the innovation may be tried on a limited basis
Observability	The degree to which the results of an innovation are visible to others
Uncertainty	The level of uncertainty surrounding the technology
Switching costs	Costs that result from commitments to the current technology

Table 1: Innovation characteristics

As stated in paragraph 1.2 the adoption decision is not only characterized by high uncertainty regarding the new technology but also regarding the NTV's liability of newness. This is because adoption by a business is commonly a long-term engagement that involves a higher degree of perceived risk. This is also inherently linked to the type of business diffusing the innovation as different firms and entrepreneurs have different risk profiles. In this sense, founding a new venture to exploit a new group of customers with a new technology can be seen as more risky as compared to aiming at an established industry with a proven business model (Chen, Shen, & Chiu, 2007). Therefore *liability of newness* is considered an additional set of evaluation criteria that is relevant to the adopter's decision. This set incorporates two concepts: (1) the NTV's *perceived capabilities* and (2) the NTV's *risk of failure*. The first relates to the ability to deliver what is promised by the NTV. This concept entails internal capabilities of the management team which is found to enhance new venture performance (Cooper, Javier Gimeno-Gasco, & Woo, 1994) and is considered a highly important assessment criterion by venture capitalists (Shepherd, 1999). For technology intensive ventures technological capabilities are obviously considered one of the most critical success factors (Lee, Lee, & Pennings, 2001). The second concept relates to the uncertainty of future existence as an NTV that aims to exploit a new group of customers with a new technology has a high risk profile compared to organizations

aiming at an established industry with a proven business model (Chen, Shen, & Chiu, 2007) This uncertainty decreases the willingness to adopt (Zacharakis, Meyer, & DeCastro, 1999). These two concepts are listed and defined in table 2.

Liability of newness concept	Definition
Perceived capabilities	Capabilities to deliver innovation as promised
Risk of failure	The risk of bankruptcy of the NTV

Table 2: liability of newness concepts

### 2.4.1 Theoretical approach

In conclusion it can be stated that the adoption decision faced by innovator-customers is characterized by a high degree of uncertainty, not merely regarding the innovation but also its newly established supplier. This will cause potential adopters to seek for information to reduce this uncertainty. This statement is underpinned by the most cited and possibly the most useful definition of information which is: “that which reduces uncertainty” (Bouazza 1989) as cited in (Case, 2007)”. Rogers (2003) defines information for the reduction of uncertainty in a decision as “patterned matter-energy that affects the probabilities of alternatives available to an individual making a decision”. Therefore an information seeking theory perspective is taken for the development of a conceptual framework that entails sources of information that are posed to influence the adoption decision. This decision entails the evaluation of the *innovation characteristics* and NTV’s *liability of newness*, as described in paragraph 2.4.

Rogers’ model describes innovation adoption as a set of subsequent steps and therefore one may argue that a process approach will be more suitable for this research. The description of process theory that is applicable to this context is an explanation of the temporal order and sequence of events based on a historical narrative (Pentland, 1999). Though this approach was found to be inapplicable because of the stage of market development and the associated ad hoc marketing practices. The latter is inherently linked to SMEs in general (Hills, Hultman, & Miles, 2008) which show a lack of formal marketing activities and are considered rather creative and informal in these practices. Moreover the fuzzy front end of market- and venture development makes trial and error a necessity to get an understanding of the dynamics of the market. Therefore a clear distinction between stages of the diffusion process can -and should not be made in light of the purpose of this research project.

The following four paragraphs will set out to explore information sources that potential adopters of an NTV can consult and how these affect their evaluation of the *innovation characteristics* and the NTV’s *liability of newness*.

### 2.5 Reference customer(s) & opinion leader(s)

The reference customer is of great importance for the development of the innovation, but also for the further diffusion of the innovation as it can be used as a showcase to gain legitimacy for the innovation and its supplier. The successful implementation of the innovation at a reference customer is a showcase for other potential adopters (Gomez-Arias and Montermoso 2007). Furthermore the successful use of the innovation by one or more reference customers confirms



its relative advantage (Salminen & Moller, 2006) and this organization's ability to overcome financial issues (Gomez-Arias & Montermoso, 2007). Both the *general image* and *share of business* of this organization have been found to determine the strength of the reference's influence (Salminen & Moller, 2006). The reference customer's *general image* is important as it can be easily accessed by potential adopters. The reference's *share of business* is an indicator of its commitment to the innovation. When a relatively high share of the reference's need for this technology is acquired from the NTV this can be regarded as an indication of its preference and commitment. Furthermore adopters require continuity in supply, service and warranty (Slater, Tomas, Hult, & Olson, 2007) and a reference customer who adopted the innovation and thus co-developed the NTV's innovation will significantly improve its chances of survival (Ruokolainen & Igel, 2004)(Popovic & Fahrni, 2004). Reference customers are thus posed to influence the *perceived innovation characteristics* and the *liability of newness* of the venture.

The fit between the reference customers' application and the intended application of the potential adopter will moderate the influence of reference customer(s). The fit between the business cases makes it easier to compare them (Ruokolainen & Makela, 2007) so the reference information will have a higher applicability. Additionally the reliability of an information source has a significant effect on the value of the source (Morrison & Vancouver, 2000). The level of independence, quality and detail increases the reliability of a source, which is in line with the findings of Chen, Shen & Chiu (2007) on communication in high-tech markets. In this context one can think of the different reliability between the mention of a reference by the NTV in contrast to a site visit to the reference customer where firsthand information is acquired. Therefore the reliability of the reference information is considered to be moderating the relationship between the reference customer and the *innovation characteristics* and NTVs *liability of newness*.

Opinion leaders are another source of information that adopters can consult to make their evaluation. These are individuals that have a significant amount of influence within their social network (Rogers, 2003) in the case of a radical innovation this individual is often active in the scientific community (Popovic & Fahrni, 2004). At this early stage of development they can increase the market's awareness of the innovation and help conceptualize it, thus they exert mainly an informative influence. Therefore opinion leaders are posed to influence the *perceived innovation characteristics*.

## 2.6 The entrepreneur's track record

A central theme in the entrepreneurial marketing literature is that of the entrepreneur in the ventures marketing strategy -and activities. In SME's the entrepreneur is commonly personally involved with the promotion and sales of new products to relevant external parties (Dunn, Friar, & Thomas, 1991). Bettiol *et al* (2012) discuss two reasons for this role of the entrepreneur. Firstly it can be due to a lack of resources that can be employed to marketing in combination with the absence of marketing structures force the entrepreneur to take personal responsibility for these tasks. Secondly, as the entrepreneur is responsible for the creation of the innovation and thus guides and keeps control over the clarification and reinforcement of the claims and propositions made. Bettiol *et al* (2012) argue that, based on their findings, the latter is the best

explanation. The credibility of the proposition is increased by this personal engagement as it is associated with the entrepreneurs' successful *track record* (Martens, Jennings, & Jennings, 2007). In addition Ruokolainen & Igel (2004) find that the entrepreneurs' working experience in a large multinational provides the managerial skills necessary for developing new products and managing customer projects. Therefore the track record of the members of the founding team is argued to influence the *perceived innovation characteristics* and the *liability of newness* of the NTV.

## 2.7 The venture's parent organization

Another important element for the success of a new venture is the amount of support that it gets from its parent organization (Steffensen, Rogers, & Speakman, 1999). NTVs can emerge from (large) corporations and from universities. Smilor (1987, as cited in Perez & Sanchez, 2003) concluded that corporate spin-offs receive more benefits from their parent organization compared to university spin-offs. These benefits entail more and diverser transfer of knowledge and access to marketing channels, suppliers, customers and physical assets such as production facilities and developed products (possibly in the form of Intellectual property). University spin-offs may therefore face more problems than corporate spin offs, as the support of a parent organization is of greater importance in the early years of an NTV (Perez & Sanchez, 2003). Nevertheless other research points out the benefits that university spin-offs receive. In research at the UT in Austin (Smilor, Gibson, & Dietrich, 1990) the founders of university spin-offs indicated that the university was the most important influence for the succesful formation and development by providing ideas and personnel additionally the university provided consultants and research expertise. Other initiatives that might be able to contribute to the success of university spin offs are, amongst others: business incubators, centers for technology transfer, business angel networks and educational entrepreneurial programs that focus on the development of non-technical skills (Smilor, Gibson, & Dietrich, 1990).

Grandi & Grimaldi (2003) performed a study on Italian university spin-offs and argue that affiliation with a university may not always be seen as positive, as it can be associated with a lack of practical experience due to the theoretical nature of a university's activities. Furthermore, entrepreneurs with an academic background are often associated with a lack of managerial competences, yet the authors add that a multidisciplinary founding team can be used to overcome this problem. This lack of practical experience is not found in relation to corporate spin-offs. Having a university as a parent organization is not only important for receiving support as several ventures in the study of Grandi & Grimaldi (2003) indicated that their connection to a parent organization was especially useful in the startup phase. At this stage the absence of a history left the market with no criteria to evaluate them. The fact that their venture originated from a credible university gave the market positive signals of the superior technological competences of these knowledge intensive ventures and thus of the NTV's *liability of newness*.

The additional benefit that corporate spin-offs may have is the image or reputation of their parental organization and its products. In a case study on the purchase of high-tech medical equipment Lindgreen et al (2009) found that the perceived value of the offering is influenced by the experience with the brand. Research on the marketing approaches used by high tech firms

resulted in similar findings as product image/reputation was considered the most important marketing tool (Traynor & Traynor, 2004). Therefore it is posed that the NTV's parent organization's *general image* influences the *perceived innovation characteristics* and the *liability of newness* of the NTV.

## 2.8 Networking capability

Networks are described in many different ways in literature but authors do agree on the definition of networks as “a firms’ set of relationships, both horizontal and vertical with other organizations including relationships across industries and countries” (Perez & Sanchez, 2003). The ability to build and use these relationships is conceptualized as *network capability* (NC), which entails the firms’ abilities to “develop and utilize inter-organizational relationships to gain access to various resources held by other actors” (Walter, Auer, & Ritter, 2006, p. 542). First of all, networking can help building the credibility of the NTV. The credibility of a supplier is argued to be an issue of size or reputation (Meldrum, 1995), in the case of an NTV launching an innovation, the first issue is inextricably related to the venture, but the latter is not. A reputation can initially be obtained by personal networking, as Johansson (1990) argues that some of the acquired resources can help solving operational problems while others “increase the firm's legitimacy in the market-place and indirectly provide access to resources needed for the pursuit of economic goals.” The underlying premise is that the venture does not have a track record yet and therefore the entrepreneur has to rely on personal credibility (Birley, 1985).

A lack of credibility thus forces the entrepreneur to use their personal network (Ruokolainen & Makela, 2007). This network can provide the venture with customers, suppliers, new employees or investments (Birley, 1985). As NTVs either originate at a corporation or a university it is more likely that the entrepreneur will rely on the network that was built while working at this organization (Grandi & Grimaldi, 2003). Though university spin-offs are found to be more active in networking with their parental organization in an earlier stage compared to corporate spin-offs (Perez & Sanchez, 2003) suggesting a different approach to networking. Furthermore networking gives the NTV access to a key resource: information. The development of a network enables the venture to acquire more accurate information which improves business (Donckels & Lambrecht, 1995). Perez & Sanchez (2003) performed a study amongst NTV managers who indicated that enrichment of their knowledge was their most important goal of networking. This knowledge mainly regarded the technological and commercial opportunities and limitations of their venture. NC as a means for anticipating market opportunities leads to a more market oriented and focused use of (scarce) resources (Walter, Auer, & Ritter, 2006).

Networking may not only provide the NTV with access to direct and indirect resources, it may also lead to the formation of strategic alliances. These strategic alliances are used for different and diverse reasons such as acquiring technology, acquire market access, reduce time to market, foster market development, source materials and components etcetera (Davies & Brush, 1997). Networking capability thus provides the NTV access to a variety of key resources and benefits and hence influences the *perceived innovation characteristics* and the *liability of newness* of the venture.

## 2.9 Theoretical framework

In this chapter a theoretical framework has been developed that is based on the work of Rogers (2003). Roger's model is modified in four ways, firstly the *liability of newness* of the NTV is added which entails its *perceived capabilities* and *risk of failure*. Even if the overall evaluation of the innovation characteristics is positive, a negative score on these factors may prevent adoption of the innovation. Secondly *uncertainty* and *switching costs* have been added to the innovation characteristics to adapt this set for radical innovations. Thirdly by drawing on information seeking theory three information sources that are argued to influence the perceived *innovation characteristics* and *liability of newness* are added. This may seem counterintuitive given the fact that innovators are believed to make an individual assessment of an innovation and break existing patterns, therefore the influence of these sources is to be considered informative rather than normative. The fourth and final modification is the aggregation of Roger's five stages in the adoption decision into one concept. This is done because of the explorative nature of this research project of which the aim is not to link influences to a specific stage, but to the adoption decision in general. These sources are the few indicators of the NTV and its innovation's ability to enhance the adopter's business processes. The conceptual framework is depicted in figure 1.

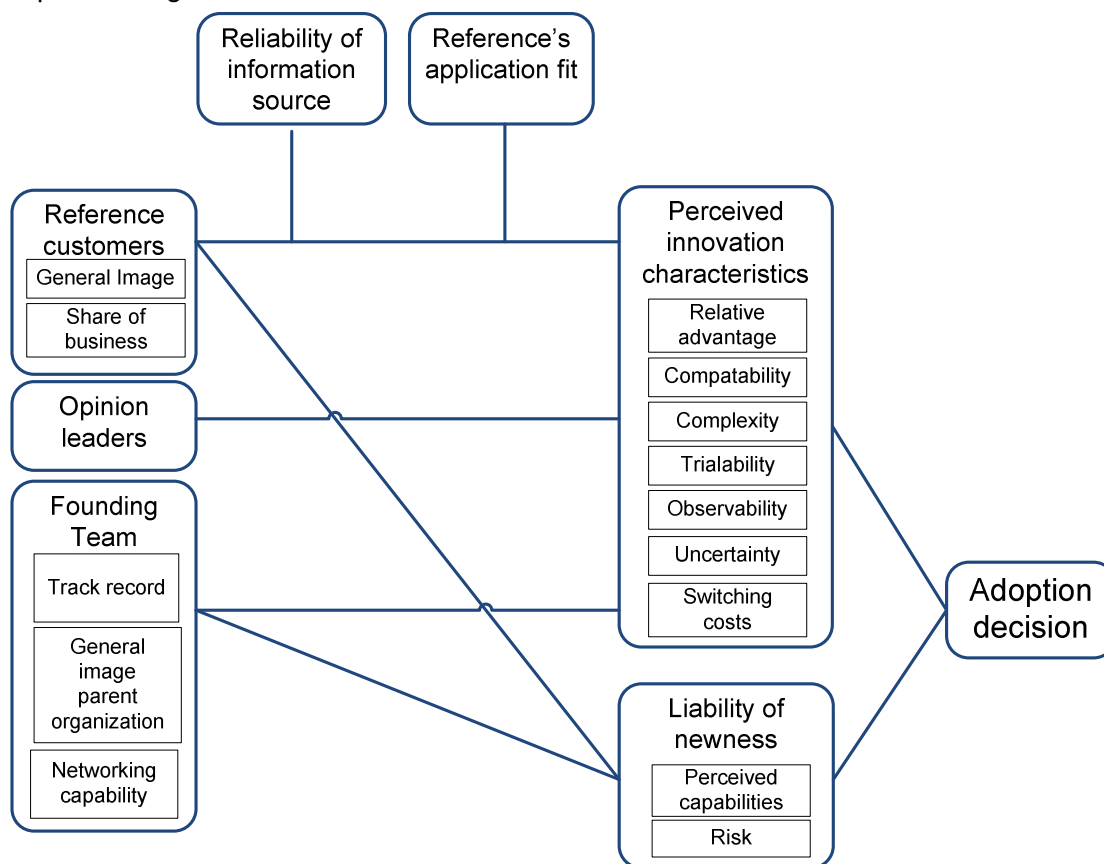


Figure 1: The conceptual framework

## 3 Within-case analysis

### 3.1 Introduction

This chapter describes the findings from each of the separate cases. The within-case analysis is the first step in making sense of the data, by looking for patterns and relationships and to make general discoveries about the phenomena being researched within a single setting. The specific aim is to generate underpinnings and/or extensions of the theoretical framework that has been developed in chapter 2. For each of the cases a general description of its origination and innovation is given and limitations are provided which are important in understanding the context of the findings.

### 3.2 Methodology

#### 3.2.1 Case selection

This kind of research is in general challenged by identifying NTVs in the early phase of existence and even more by getting their customers to cooperate. The cases for this research are selected theoretically, thus focusing efforts on cases that are theoretically useful by fitting in conceptual categories (Eisenhardt, 1989). These categories are based on the theoretical framework which describes recently established organizations that originated from a university or large corporation and are engaged with commercializing an innovation with a substantially new core technology. Typical cases would fit the following criteria: active 5 years or less, less than 10 employees and a high R&D intensity/radical technology. The latter criterion is difficult to assess and therefore a general indication of the level of competition is taken as a measure for the stage of development of the market hence the newness of the technology. The initial sample consisted of 15 NTVs as these were collectively involved in a research grant application project that was managed by the Eindhoven university business club in cooperation with the universities' innovation lab (business incubator). Two cases were omitted because these were ventures that consisted of just one entrepreneur delivering an IT-service billed by the hour and thus not of much use for this research. Two other cases were excluded because the transferred product incorporated no radical technology but only their production technologies (production of algae and 3D videos) did. Another three NTVs were not willing -or too busy to cooperate. Thus a total of eight NTVs were included in the study which is in line with the guidelines of Eisenhardt (1989) to be able to establish replication. Though efforts to involve their customers were not successful due to confidentiality and practicality and therefore this research will focus on the NTVs perspective and study the interaction between them and their customers. This is an approximation of the actual object to be studied, but nevertheless is believed to provide relevant insights to achieve the research objective. An overview of the cases can be found in appendix 3. Relevant deviations from the abovementioned criteria are described in the limitations of the case focusing on the consequences for the generalizability of the findings of the case. The sample is relatively heterogeneous in terms of phase of development, age, innovation and industry which is considered valuable when the aim of a research project is to explore and identify central themes across a variety of cases (Ritchie & Lewis, 2003).

### 3.2.2 Data collection

#### Interviews

The main data for this research project is collected by performing semi-structured interviews with the founder, CEO and/or other executives of the NTV. Interviewing is a method used to collect verbal histories and thus a form of participant observation (Neergaard & Ulhol, 2007). Evidence of verbal histories is retained in the form of an actuality, which are in this instance the audio recordings that were taken during the interview with permission of the participant. The evidence collected with this method is subjective as it involves sense-making of the participant, a process of connecting the interpretation of the current situation to that of the past (Neergaard & Ulhol, 2007). The main advantage of verbal histories is that it has the potential to provide evidence that would not be found using other methods of data collection. The interview protocol that is used can be found in appendix 1. These questions serve as the basis for the interviews but additional questions were asked for clarity and to explore additional topics that arose during the interviews. The interview is thus set up as a guided conversation aimed at gaining insights in the perceived causal explanations of the interviewee. These features are considered the strengths of interviews as a source of evidence (Yin, 2009). The interviews were conducted with another researcher working on a related project. This enabled the researcher to take somewhat of a distance from the conversation and take notes or formulate additional questions, which is likely to improve the evidence from the interviews.

#### Archival sources and documentation

The data that was obtained from the interviews is checked for accuracy and complemented with data from archival sources and documentation related to the venture's marketing activities. These sources entail publicly available materials such as websites, leaflets, fair presentations and press releases.

### 3.2.3 Data analysis

The interviews are transcribed which resulted in about 75 pages of data. Coding is used to summarize, synthesize and sort this information and is the fundament of developing the analysis. By studying and coding the data the researcher begins to create order in a series of otherwise discrete events, statements and observations (Charmaz, 1983). In the process of coding the data is labeled, compiled and organized (Bryman, 2008). A selective coding approach is used to prevent getting lost in the overwhelming amount of data. This is a procedure in which core categories, a central issue or focus, are selected from the conceptual framework. This secures that categories are meaningfully interrelated (Miles & Huberman, 1994). Each of these core categories is operationalized by adding related concepts and their definitions which have a code assigned to be used in the coding process. The conceptual framework as presented in chapter 1 therefore serves as the basis for this analysis. Firstly the general findings on the diffusion- and adoption of the innovation are provided. The rest of the findings are listed under the information source they are related to, these are: *reference customers*, *opinion leader* and *founding team*. As a result of the within case analysis another two information sources are added to this list which are argued to be of influence on the adoption decision. These are: *advisory board* and *partnerships*. Moreover the influence of the



information source opinion leader is discussed more broadly than the commonly used *sentiment regarding the new technology*, this because it was found that this individual's opinion also regarded the venture's liability of newness.

### 3.3 Findings

#### 3.3.1 Alpha

<b>Founding year</b>	2001
<b>Parent organization</b>	NXP semiconductors (corporate)
<b>Position interviewee</b>	Manager process development
<b>Innovation</b>	Machines for laser cutting wafers with multiple beams
<b>Market</b>	Semiconductors

##### 1. Description

The founders of the venture were involved in a project at their former employer for the development of a new technology for dicing wafers with the use of multiple laser beams. This new technology was patented and the founders decided to market this technology with their own venture. Current methods for dicing wafers use either diamond cutting plates or a single laser beam while Alpha's technology makes use of multiple laser beams. The main advantage of this technology is the smaller cutting grooves which enable customers to put more devices on one wafer and cut more precisely. The latter is especially relevant for some market segments where components are becoming ever smaller.

##### 2. Limitations

The interviewee has joined the company about one year ago thus his knowledge of the company's initial phase(s) is from others and might be biased. But as he is in an executive position and has been working in the semiconductor industry for many years his insights can be considered quite valuable for this research project. Additionally the company is beyond the start-up phase as they have been active for over 10 years and directly employ 40 FTE.

##### 3. Findings

###### Diffusion & adoption process characteristics

Alpha was able to attract a reference customer with whom they finalized their innovation for one of the four segments of the semiconductor market. Hereafter they became more active in marketing by visiting and attending fairs and conferences, and utilizing the network that the founding team had built at their parent organization. The interviewee describes the market as a 'small world' where every actor keeps track of each other which may result in a high degree of observability. The market is rather conservative due to the high quality standards in the industry making technological progress complex, expensive and time-consuming though the competitiveness of the market forces organizations to innovate. As soon as a potential customer has shown interest an active personal-selling and negotiation process is started. Customer

projects are carried out in phases and by close cooperation which can be argued to reduce uncertainty and complexity (stepwise) whilst increasing trialability. Furthermore customer's buying motives seem to be rational and focused on increased efficiency and cost reduction. Alpha has acquired several research grants which allowed them to perform more, and more 'exotic' R&D and hereby allowing them to enter other market segments successfully.

#### Reference customer(s)

The interviewee describes the reference customer as a partner that helped them to finalize their innovation. For subsequent customers the innovation needs relatively minor adjustments which means that there is a high application fit between the business cases making the reference information highly applicable (Ruokolainen & Makela, 2007). But as Alpha's customers are competitors the reference information is considered confidential and cannot be shared in much detail. Legal contracts are drafted to protect this information which means that this information is not independent, rich and detailed and thus unreliable (Chen, Shen, & Chiu, 2007). Though the interviewee recognizes the importance of a reference customer as according to him only a finished and fully operational innovation can be sold because customers demand equal or better reliability (uptime) and quality than their current technology. He underlines this proposition by saying "success at a customer attracts new customers". The mere existence of a reference customer is argued to acknowledge (some of) the innovations' relative advantage as the business cases for the different customers are highly similar. Next to this, the reference customer is argued to reduce the uncertainty regarding the innovation as it ought to be operational. Furthermore it is argued that the reference customer proves that the NTV is able to live up to its promises, at least for this customer and assuming a successful completion of the project, increasing its perceived capabilities. This first customer has most probably provided revenues or even profits which is argued to decrease the perceived risk of failure of the NTV.

#### Founding Team

The NTV's parent organization is one of the shareholders of the venture and is utilized for quality control as they have the right equipment. Both of these matters are communicated to potential adopters, which is argued to decrease the customer's perceived risk of failure and respectively increases the NTV's perceived capabilities due to the recognition of the credibility by the parent organizations' investment and their technical support on a critical requirement. Being affiliated with Philips has helped to persuade customers as it gives a certain status being considered a subsidiary. Philips has the status of a technology leader, which is argued to increase the perceived relative advantage and additionally reduce uncertainty regarding the innovation. The interviewee also indicates that this link provides protection from competition who feared infringing the IP of "the big and strong" Philips who are capable of defending their patent, which is argued to decrease the perceived risk of failure. Furthermore the contacts that Philips provided were of great value, not only by knowing the right person to contact within an organization of interest, but also from the customer's perspective as they "know who they are dealing with". Therefore it is argued that the entrepreneur's track record increases the NTV's perceived capabilities.



### Partnerships

To build and maintain a “leading edge” image, Alpha participates in R&D projects with a major national research organization and Eindhoven University of technology. Next to this R&D on customer projects is also significantly outsourced to several partners. Additionally A’s machines are produced at a highly regarded manufacturer of high-tech systems, underlined by the quote “even ASML manufactures here”. These partnerships are communicated to their customers and additionally visits to the partner’s production facilities are organized. This outsourcing of R&D and production enables A to focus on their core-competences and select the best parties to cooperate with and thus it is argued to strengthen their perceived capabilities while it reduces uncertainty regarding the innovation.

### Advisory board

Alpha has a formal advisory board that consists of technical- and market specialists and of more finance orientated investors. These individuals are consulted for the major business decisions related to topics as R&D, strategy and finance. This is communicated to customers and their role in managing the business is argued to reduce the perceived risk of failure and to increase perceived capabilities due to their experience and credibility.

## 3.3.2 Beta

<b>Founding year</b>	2009
<b>Parent organization</b>	Eindhoven university of technology (academic)
<b>Position interviewee</b>	CEO
<b>Innovation</b>	Machines for the production of emulsions
<b>Market</b>	Pharmaceutical

### **1. Description**

Beta’s technology was developed and patented as a result of a graduation project of one of the founders at a research group of the university. The product is a production technology for emulsions that enables a better control over the particle size and with this improves the blending of multiple substances in a product. This results in products of a higher quality that need less material to produce.

### **2. Findings**

#### Diffusion & adoption process characteristics

Beta has so far succeeded in attracting several reference customers for whom they performed relatively small projects. Customers are found by attending industry fairs where, according to the interviewee, executives of organizations are actively seeking for new technologies. Because Beta’s technology is very different from current production technologies change is complex, expensive and time-consuming. As soon as a potential customer has shown interest an intensive and prolonged negotiation process is started. Customer projects are carried out in phases and by close cooperation which can be argued to reduce uncertainty and complexity (stepwise) whilst increasing trialability. Additionally to deal with complexity the customer involves technical specialists whilst Beta provides extensive explanation and material

concerning their technology. Furthermore customer's buying motives seem to be rational and focused on increased product quality and cost reduction. Beta has acquired several research grants which allowed them to perform R&D activities and hereby improving their innovation and level of knowledge and skills.

#### Reference customer(s)

The technology of Beta is applicable to different substances and so far each of the customer projects has been unique which means there is a low application fit. Because of this reason and furthermore due to confidentiality the use of reference information is very limited. The interviewee describes how he mentions a reference customer to subsequent customers as "a top 10 organization in the industry". To which adds that this mention of success at this customer is helpful as it proves that the NTV is able to live up to its promises, at least for this case, and is thus argued to increase the NTV's perceived capabilities. Furthermore this first customer has most probably provided a stream of revenues which is argued to decrease the perceived risk of failure.

#### Opinion leader

Beta receives support and advice from a university professor who can be considered to have a significant amount of influence within his social network, hence an opinion leader (Rogers, 2003). Moreover this individual refers them to potential adopters. The fact that this influential individual recognizes the credibility of the organization and its innovation is argued to increase the perceived relative advantage of the innovation, to reduce uncertainty and to increase perceived capabilities.

#### Founding team

Beta profiles itself as an Eindhoven university spin-off as they believe this gives them a certain status. The innovation has been developed in a research group of the university and the professor that heads this group is a member of the venture's advisory board. This university is highly regarded for its technological capabilities in research and education, which is argued to increase the NTV's perceived capabilities and reduce the uncertainty regarding the innovation.

#### Advisory board

Beta has a formal advisory board with members from both the academic as from the business community. This group is consulted for all kinds of issues and advice. This is communicated to customers for who this support by senior and experienced individuals is argued to decrease the perceived risk of failure and increase the NTV's perceived capabilities as these persons are involved in managing the venture.

### 3.3.3 Gamma

<b>Founding year</b>	2009
<b>Parent organization</b>	Eindhoven university of technology (academic)
<b>Position interviewee</b>	Managing director
<b>Innovation</b>	Micro reactor technology
<b>Market</b>	Chemical

#### *1 Description*

The founder's graduation project concerned micro reactors and the idea to market this technology was raised. The venture offers customers a service to calculate and construct a micro reactor for production purposes. This technology is used to produce chemical substances which in comparison to conventional production methods produces substances of a higher quality with less waste while being much safer due to reduced heat emission.

#### *2 Limitations*

Gamma is developing a tangible product but currently only provides a service for which the marketing is distinct from that of a tangible product. The intangibility of a service makes it difficult for organizational buyers to evaluate the purchase (Valk & Rozemeijer, 2009). Other researchers point out that the purchase of services is more complex because it implies different risks for the buyer with regard to evaluating the vendor and the service (Fitzsimmons, Noh, & Thies, 1998). Although a part of Gamma's service is ordering components on behalf of the customer to build their installation, which puts this case in the midst of the tangibility spectrum.

#### *3 Findings*

##### *Diffusion & adoption process characteristics*

Gamma has so far succeeded in attracting several reference customers through the network of their former research group at the university and by attending industry fairs. Herewith they have managed to build a 'pool of leads' who have shown interest but still have to be fully convinced or are busy generating sufficient resources to start a project. Because Gamma's technology is very different from current production technologies the change process is complex, expensive and time-consuming for potential adopters. Complexity is of even more concern as customers are commonly medium sized organizations who do not possess sufficient technological expertise. As soon as a potential customer agrees to start a project an intensive and prolonged negotiation process is started. Customer projects are carried out in phases and by close cooperation which can be argued to reduce uncertainty and complexity (stepwise) whilst increasing trialability. Furthermore customer's buying motives seem to be rational and focused on safety and cost reduction. For the latter Gamma has developed a software tool to be able to calculate economic returns quickly and relatively easily. Gamma has acquired several research grants which allowed them to perform R&D activities and hereby improving their innovation and level of knowledge and skills. This is of more importance for their business model as they charge customers by the hour and thus have rather limited streams of revenue.

### Reference customer(s)

Each customer's application differs on the substances to be processed by the micro reactor which means that the application fit is low and as a result the reference information has a low applicability. Sharing this information, as described by the interviewee, is limited to "we did this and that for a customer" which makes the reliability low (Chen, Shen, & Chiu, 2007). Though the reference customer is considered a good place to learn and gain experience which is useful in persuading new customers. This is illustrated by citing a subsequent customer saying "these guys know what they are talking about". Therefore it is argued that the mere existence of a reference customer increases the NTV's perceived capabilities. This first customer has most probably provided revenues or even profits, decreasing the perceived risk of failure of the NTV.

### Founding team

Gamma emphasizes its origination at the Eindhoven University of technology as the university is highly regarded for its technological capabilities in research and education. The venture is located on the campus which provides them with easy access to knowledge and experience, illustrated by the quote "there is always someone who knows the solution to our problems". Additionally Gamma can make use of some facilities and equipment. Customers are regularly invited for a site-visit to their facilities and are thus aware of Gamma's access to- and utilization of high quality knowledge which is argued to increase the NTV's perceived capabilities and to reduce the uncertainty regarding the innovation.

### Opinion leader

Gamma has repeatedly been referred to potential adopters by a university professor who can be considered to have a significant amount of influence within his social network, hence an opinion leader (Rogers, 2003). The fact that this influential individual has a positive sentiment regarding the innovation and in addition recognizes Gamma as a credible organization is argued to increase the perceived relative of the innovation, reduce its uncertainty and increase the NTV's perceived capabilities.

### Advisory board

Gamma has a formal advisory board which consists of a university professor, someone from the universities' incubator an industry expert and a financial expert. This board provides support and advice in running the business and additionally refers them to parties in their network such as potential partners or customers. The interviewee emphasized their importance by stating "they increase our trustworthiness" and "we ourselves don't know much about money". The existence of an advisory board is communicated to customers for who this support by senior and experienced individuals is argued to decrease the perceived risk of failure and increase the NTV's perceived capabilities as these persons are involved in managing the venture.

### Partnerships

Gamma performs some of its customer projects in cooperation with a large engineering firm. This firm is capable of constructing and financing a full plant, for which Gamma is too small in terms of personnel and funds. Gamma contributes to these projects with their knowledge of

micro reactors. This cooperation has been important for the company as it provides them a stream of revenue and additionally it enables them to participate in larger projects than they would be able to alone. For potential adopters it is argued that this partnership increases the firms' perceived capabilities and it also decreases the perceived risk due to the generated revenue. Additionally it is argued that because of the acknowledgement of the credibility of the innovation by this partner this partnership reduces the uncertainty about the innovation.

### 3.3.4 Delta

<b>Founding year</b>	2008
<b>Parent organization</b>	Drager medical (corporate)
<b>Position interviewee</b>	CEO
<b>Innovation</b>	Respiratory modules
<b>Market</b>	Medical equipment

#### 1 Description

The founders of Delta were involved with the development of the 2nd generation respiratory module based on turbine technology at their former employer until they were laid off due to restructuring plans. They decided to start for themselves and develop and market their own 3rd generation model. This product is sold to OEMs who incorporate it in their own respiratory modules. Compared to current alternatives this model is smaller and has a lower total cost of ownership due to reduced maintenance and use of bottles of oxygen. An additional advantage for customers is the reduced time-to-market as they no longer have to develop this complex component themselves.

#### 2 Findings & Discussion

##### Diffusion & adoption process characteristics

Delta has so far succeeded in attracting several reference customers mostly through the network that the founding team built at their previous employer. Additionally the venture regularly attends industry fairs and conferences to extend this network and find more potential customers. The majority of projects concern the development of a vital component to be incorporated in the customer's product. This increases the interdependency and results in an intensive and lengthy negotiation process. Customer's buying motives seem to be rational and focused on decreased time-to-market and reduced costs. The venture experienced that a multidisciplinary decision making unit was easier convinced of the benefits of adopting the innovation. Such a team evaluates the business case as a whole instead of just as an acquisition of a new technology which R&D departments seemed to oppose in a sense of 'not invented here'. Furthermore Delta has acquired several research grants which were crucial to them to perform R&D activities and hereby improve their innovation and level of knowledge & skills.

##### Reference customer(s)

The requirements do not differ significantly between customers enabling Delta to develop a reliable platform that needs relatively minor adjustments for each new customer. This implies a

high application fit between the business cases making the reference information highly applicable (Ruokolainen & Makela, 2007). But because Deltas customers are competitors the reference information is considered confidential and cannot be shared in much detail. Legal contracts are drafted to protect this information which means that this information is unreliable (Chen, Shen, & Chiu, 2007). As an alternative the venture has developed a fully functional prototype to show what they are capable of and thus indirectly sharing reference information. The mere existence of reference customer is argued to acknowledge and increase (some of) the innovations' perceived relative advantage as the business cases for the different customers are similar. Furthermore it reduces a part of the uncertainty as a working prototype is being presented. Furthermore it is argued that the reference customer proves that the NTV is able to live up to its promises, at least for this customer and assuming a successful completion of the project, increasing its perceived capabilities. This first customer has most probably provided revenues or even profits, decreasing the risk of failure of the NTV.

#### Founding Team

The NTV's parent organization gives the venture a big advantage through its reputation which is used in persuading customers by stating "we provide you access to the technology of the market leader". Additionally the NTV was given basic office equipment as desks and chairs and more importantly some specific measurement tools. Furthermore the founding team has an excellent track record and a lot of experience and many useful contacts in the business which is communicated to their customers. The founding team's link with their parent organization and track record are therefore argued to reduce the uncertainty regarding the innovation and to increase the NTV's perceived capabilities. The founding team's networking capability is difficult to link to any outcomes due to the latent nature of this concept but in this case the influence of the networking capability was more concrete. The interviewee underlined the importance of networking by referring to it as "extremely valuable" in keeping track of the industry and to acquire contacts. Because nearly all of the NTV's potential customers, (clinical) partners and suppliers are obtained through the network built at their previous employer it is argued that the networking capability increases the perceived capabilities of the NTV as it provides access to a rich source of skills and knowledge.

#### Partnerships

Delta has several partners, for example for the research and development of software and electronics, which enables them to work with highly regarded and highly skilled parties. Additionally all of their production is performed by an external party. Customers perceive the business as risky, mainly concerning their continuity of supply and ability to deliver what is promised. To reduce this perceived risk, audits are performed at their partners for which they received several ISO certificates. These partnerships with credible partners are communicated to their customers which is argued to increase Deltas perceived capabilities and to decrease uncertainty regarding the innovation.

### 3.3.5 Epsilon

<b>Founding year</b>	2009
<b>Parent organization</b>	Eindhoven university of technology (academic)
<b>Position interviewee</b>	CTO
<b>Innovation</b>	Conductive inks
<b>Market</b>	Conductive materials

#### *1 Description*

One of the founders was working on a PhD dissertation project in which a conductive ink was developed. The inductive ink is used in all kinds of products that contain flexible electronics and is more stable and cheaper compared to other inks available.

#### *2 Limitations*

The interviewee is the CTO of the company thus he is more involved with the technical side of the business and his perspective on the topic of this research project might be limited. But as he has been involved in the venture from the beginning it is assumed that his perspective is sufficient for explorative purposes.

#### *3 Findings & Discussion*

##### *Diffusion & adoption process characteristics*

Epsilon had a somewhat troubled start because of their focus on one party that was interested in their technology causing them to develop an unsuitable printing technology. This party eventually discontinued the project as they were incorporated in another organization. Currently Epsilon is involved in several customer projects from which they try to get as much input and feedback to improve their innovation. These customers were mostly found through the network of the venture which was mainly built through the membership of an industry association. Because Epsilon's technology and associated production technology is very different from current technologies the change process is complex, expensive and time-consuming for potential adopters. Customer projects are carried out in phases and by close cooperation which can be argued to reduce uncertainty and complexity stepwise whilst increasing trialability. Furthermore buying motives seem to be rational and focused on cost reduction but, in this case also very dominantly on the specific advantages of the product, related to its improved printability and longer shelf life.

##### *Reference customer(s)*

The business cases of each of the customers differ significantly which results in a low application fit (Ruokolainen & Makela, Constructing a market domain model for start-up software technology companies: A case study, 2007). Additionally the information that is shared is limited to a simple mention, making the reference information unreliable (Chen, Shen, & Chiu, 2007). Because of these reasons the use of reference information is very limited. Though the interviewee adds that a mention of success with previous customers is helpful in persuading others as it proves that the NTV is able to live up to its promises, at least for these cases, and is



thus argued to increase the NTV's perceived capabilities. Furthermore this first customer has most probably provided a stream of revenues which is argued to decrease the perceived risk of failure of the NTV.

### Founding Team

Because the innovation was developed at the university they financed the IP and have given Epsilon a free license. Furthermore they cooperate with a professor and a research group from the university which is very useful for the (further) development of the innovation. This relation with the university is argued to increase the NTV's perceived capabilities and reduce the uncertainty regarding the innovation. The founding team's networking capability is difficult to link to any outcomes due to the latent nature of this concept but in this case the influence of the networking capability was more concrete. The interviewee underlined the importance of networking and especially to acquire contacts such as partners, suppliers and potential customer. Epsilon is a member of an association for the conductive materials industry where they carry out R&D activities and have access to a very large network. Therefore the networking capability is argued to increase the perceived capabilities of the NTV as it provides access to a rich source of skills and knowledge.

### Partnerships

Epsilon participates in R&D projects with several parties such as research groups of the university and companies in the printing industry, for instance a project on inkjet-printing from which they get a lot of knowledge of the production process that their inks are used in. Furthermore Epsilon has agreements with a large company in the chemical industry to produce larger batches of their product, this after customers repeatedly doubted Epsilon's ability to deliver large batches if needed. These partnerships are communicated to their customers. These partnerships for R&D and production enable Epsilon to select the best parties to cooperate with and thus it is argued to strengthen their perceived capabilities while it reduces uncertainty regarding the innovation.

### **3.3.6 Zeta**

<b>Founding year</b>	2010
<b>Parent organization</b>	NXP Semiconductors (corporate)
<b>Position interviewee</b>	CEO
<b>Innovation</b>	MEMS prototyping service and high-frequency measurement device
<b>Market</b>	Semiconductor

#### **1 Description**

In the position of project manager at NXP the founder saw the potential for his own venture as customers of repeatedly asked for the production of (small) batches of MEMS (Micro-ElectroMechanic Systems) in which NXP had no interest. Zeta assists customers in making a prototype production-ready. Next to this service the development of a high-frequency measurement device has been initiated. This device will be applied in medical imaging



equipment. The advantage of this product is its size as current alternatives are relatively large and heavy making imaging equipment hard to handle and immobile.

## **2 Limitations**

Zeta is developing a tangible product but currently only provides a service for which the marketing is distinct from that of a tangible product. The intangibility of a service makes it difficult for organizational buyers to evaluate the purchase (Valk & Rozemeijer, 2009). Fitzsimmons et al (1998) point out that the purchase of services is more complex because it implies different risks for the buyer with regard to evaluating the vendor and the service.

## **3 Findings & Discussion**

### Diffusion & adoption process characteristics

Zeta has so far succeeded in attracting several reference customers through the network that was built at its parent organization and by attending industry fairs. As Zeta's customers are more active in the academic and advanced research community attending conferences or even presenting research proceedings is very useful to create awareness. The interviewee describes this community as a 'small world' where personal credibility is of great importance. Complexity is not so much of a concern as customers are commonly in possession of high technological expertise. Zeta's service is rather unique as this is one of the few providers that possesses this specific knowledge and has access to production facilities. Though due to a recent closure of the production facilities that Zeta was utilizing several customer projects have been discontinued. Recently Zeta has initiated the development of a product that can be used in medical imaging equipment. This project is still in a premature phase and Zeta does not plan to involve customers until a prototype is finished as they believe a 'proof of technology' is necessary to enter the market. Zeta has acquired several research grants which allowed them to perform R&D activities and increase their knowledge and skills.

### Founding Team

The business benefits a lot from the entrepreneur's track record, as he and his model are widely known in the industry illustrated by the quote "billions of microchips are produced using my model". Furthermore the entrepreneur has a lot of experience and many useful contacts in the business which is communicated to the venture's customers. The entrepreneur's track record is therefore argued to reduce the uncertainty regarding the innovation and to increase the NTV's perceived capabilities.

### **3.3.7 Eta**

<b>Founding year</b>	2010
<b>Parent organization</b>	Eindhoven university of technology (academic)
<b>Position interviewee</b>	Managing director
<b>Innovation</b>	Smart football goals and video analysis system
<b>Market</b>	Sports equipment

## **1 Description**

The research group where the graduation project of one of the founders was conducted was working on products that combined technology, fun and sports to motivate children and elderly people for physical activity. This led to the product 'Smartgoals' a set of cones connected with a bar to be used as a goal. The cones have built in LEDs and communicate with the other goals creating an interactive and more dynamic training. The other product is a video analysis system that can be used on the spot by trainers and coaches to analyze sport-games.

## **2 Limitations**

The market in which Eta operates can be considered business to business but a football club has different buying motives than most businesses as the product is not of use in their value chain. This makes this case less relevant for this research project.

## **3 Findings**

### Diffusion & adoption process characteristics

Eta has two products in its portfolio, the first is a video-analysis system that has had several field tests though this is currently not their main focus as they believe their other product, a set of cones that can be used for interactive football training, has more potential. Thus far Eta has been busy with finalizing this product and getting it ready for production. A football club was involved in the development process in an early stage to get an understanding of the market requirements. Furthermore Eta has successfully attracted an investor which will also be responsible for the entire production. The interviewee describes the football community as a 'world of heroes' where personal credibility is of great importance. Therefore the plan was raised to have a well-known football trainer promote the product in a movie clip and use his input for the training programs in the product. Currently Eta is concerned with the preparations of the official launch of their 'smart goals'.

### Parent organization

Eta emphasizes its origination at the Eindhoven University of technology as the university is highly regarded for its technological capabilities in research and education. The IP for which Eta has an exclusive license has been developed in a research group at the university. This link with Zeta's parent organization is argued to increase the NTV's perceived capabilities and reduce uncertainty regarding the innovation. The marketing director that joined the company is an experienced entrepreneur who managed to attract a new investor and a partner for the production of their product. Therefore it is argued that the founding team's track record increases its perceived capabilities.

### Opinion leader

The interviewee describes the football community as a "world of heroes". Therefore Eta has found a famous trainer willing to star in their promotion movie who can be considered to have a significant amount of influence within his social network, hence an opinion leader (Rogers, 2003). He describes the product as a great new way of training and additionally he helped developing the training programs for which the product can be used. His positive sentiment

towards the innovation is argued to increase the perceived relative advantage and to decrease the uncertainty regarding the innovation.

Partnerships

Eta experienced that potential adopters questioned their ability to deliver what they promised. Therefore Zeta started a partnership with a highly regarded industrial company who are now responsible for the production of the product and furthermore invested in the venture. This partnership is communicated to potential adopters which is argued to: reduce their perceived risk, to increase the perceived capabilities of the NTV and to decrease the uncertainty regarding the innovation.

**3.3.8 Theta**

<b>Founding year</b>	2007
<b>Parent organization</b>	Eindhoven University of Technology (academic)
<b>Position interviewee</b>	CEO
<b>Innovation</b>	Video content analysis software and components
<b>Market</b>	Video content analysis

**1 Description**

The founder of Theta was working as project manager at Logica (software company) and responsible for developing video content analysis software. He was still in contact with the professor that supervised his Phd. Because of his experience with content analyses the idea to start a venture to sell video content analysis software was raised. This software can be used in a wide range of applications, from security systems to retail stores and production processes.

**2 Limitations**

Theta is developing a tangible product but currently only provides a service for which the marketing is distinct from than that of a tangible product. The intangibility of a service makes it difficult for organizational buyers to evaluate the purchase (Valk & Rozemeijer, 2009). Fitzsimmons et al (1998) point out that the purchase of services is more complex because it implies different risks for the buyer with regard to evaluating the vendor and the service.

**3 Findings**

Diffusion & adoption process characteristics

Theta has so far succeeded in getting several reference customers which were mainly found through the founding team’s network and for which they performed rather diverse projects. To improve their growth potential Theta has decided to focus on intelligent observation software. Currently they are working on some larger projects and in parallel are busy developing more standard products to be able to sell these to system integrators and hereby generate larger and more certain streams of revenue. Theta’s main competitive advantage is the flexibility and specific expertise that not many organizations possess. Recently a more formal marketing and sales strategy was adopted and Theta organized a seminar where they presented their

company and its products to a wide variety of parties. As soon as a potential customer agrees to start a project an intensive negotiation process is started. This process is complex and time-consuming which seems to be caused by a high degree of perceived uncertainty as each customer project is new and has its specific challenges. Theta has acquired several research grants which allowed them to perform R&D activities and hereby improving their innovation and level of knowledge & skills. Though because of these grants the focus has been too much on research causing customer projects to be somewhat neglected.

#### Founding team

Theta emphasizes its origination at the Eindhoven University of technology as the university is highly regarded for its technological capabilities in research and education. The venture is located on the campus which provides them with easy access to knowledge and experience, in example they cooperate regularly with a research group of the university. Customers are thus aware of Theta's access to- and utilization of high quality knowledge which is argued to increase the NTV's perceived capabilities and to reduce the uncertainty regarding the innovation. The founder of Theta has an excellent track record in the industry. He has several years of experience both in research and in management of video content analysis projects, which is argued to increase the NTV's perceived capabilities and to reduce uncertainty regarding the innovation. The founding team's networking capability is difficult to link to any outcomes due to the latent nature of this concept but in this case the influence of the networking capability was more concrete. Because a significant number of potential customers, partners and employees are found through networking this is argued to increase the NTV's perceived capabilities.

#### Advisory board

Theta has a formal advisory board which consists of a university professor and several shareholders. This board mainly provides financial advice. For sales and marketing issues an external expert is consulted. The existence of an advisory board is communicated to customers for who this support by senior and experienced individuals is argued to decrease the perceived risk of failure and increase the NTV's perceived capabilities as these persons are involved in managing the venture.

## 4 Cross-case analysis

### 4.1 Introduction

This chapter describes the cross-case analysis in which the findings of the within-case analyses are compared to find meaningful similarities and differences. This analysis aims at testing the applicability of the theoretical framework across cases and if necessary the framework is adjusted or extended based on the findings. Each of the information sources that were found in the within-case analysis are discussed separately. This is done because the resulting models are more comprehensive than the conceptual framework which would cause it to be too complex to fit into one model. The research assignments that are carried out in this chapter are:

#### **Assignment 2:**

Underpin and extend the conceptual framework by analyzing the NTV-customer interaction in the early stages of commercialization.

### 4.2 Methodology

The cross-case analysis is the final step in the analysis process in which the findings of the individual cases are compared and contrasted following a comparative method (Ragin, 1987). To do so comparison tables are drafted that contain the findings of the within-case analysis for each of the main concepts. Thus for each of the cases a description of the specific concept and the outcome(s), which is the influence on the innovation characteristics or liability of newness, are provided. This is done to reveal patterns in search of similarities and differences. Furthermore to find causal explanations case characteristics are added to be able to link similarities or differences to causal conditions, though not all outcomes were found to have a causal explanation. These comparison tables are provided with each of the concepts concerned. Additionally theoretical insights are added to strengthen the underpinnings of the causal explanations.

## 4.3 Findings

### Reference customers

Case	Concepts			Causal condition	Outcome(s)	
	Reference customers	Reliability	Application fit	(in)tangible innovation	Innovation characteristics	Liability of newness
<b>Alpha</b>	Used to finalize innovation. Important for persuading customers	Low, obstructed by confidentiality. Mention of success “major and well known customer”	High, minor adjustments	Tangible	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Relative advantage         </div> <div style="display: flex; align-items: center;">  Uncertainty         </div> </div>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Risk         </div> </div>
<b>Beta</b>	Place to learn, Important for persuading customers	Low, obstructed by confidentiality. Mention of success “top ten organization in industry”	Low, unique projects, major R&D work	Tangible		<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Risk         </div> </div>
<b>Gamma</b>	Place to learn, naming success is helpful	Medium. Mention of success in testimonial	Low, unique projects, major R&D work	Intangible		<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Risk         </div> </div>
<b>Delta</b>	Used to finalize innovation, naming success is helpful	Low, general description of customer and project	High	Tangible	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Relative advantage         </div> <div style="display: flex; align-items: center;">  Uncertainty         </div> </div>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Risk         </div> </div>
<b>Epsilon</b>	Used to finalize innovation. Important for persuading customers	Low, general description of customer and project	Low, unique applications	Tangible		<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Risk         </div> </div>
<b>Zeta</b>	Place to learn, naming success is helpful	Low, Obstructed by confidentiality	Low, unique projects	Intangible	<i>No concrete relevant outcomes</i>	<i>No concrete relevant outcomes</i>

Table 3: reference customers comparison table

In six of the eight cases the interviewees indicated the existence of one or more (relevant) reference customers (see table 3). Sharing information of these reference customers is considered to be important for the successful persuasion of potential adopters though this act is hampered because of two reasons. The first reason is that reference customers consider this information to be confidential even when subsequent customers are not competitors. The NTV is restricted to a simple mention of the reference customer's general image and its share of business which makes this information unreliable (Chen, Shen, & Chiu, 2007). The second reason is due to the significant difference between the adopter's business cases as found in four of the six relevant cases. This low application fit makes the applicability of the reference information low (Ruokolainen, 2007). Hence the direct reference information is generally found to be unreliable and/or inapplicable and is therefore argued to have a minor positive influence on the adoption decision. The use of the reference customer's general image and share of business is added to the model as *prestige* (see figure 2). Though reference customers are considered a *place for learning* (Beta, Gamma, Eta) or a *partner for finalization of the innovation* (Alfa, Delta, Epsilon). The NTV learns *inter alia* about customer requirements and the dynamics of the industry enabling them to make technological and organizational developments. This makes the mere existence of a reference customer important to the adoption decision of subsequent adopters. Therefore a second reference information source is added which is named *development*. This source consists of three separate concepts that contain reference information and can be consulted by adopters, these are: *product data*, *knowledge & skills* and *revenues*, and will be discussed separately below.

#### [Product data](#)

When the case entails a tangible innovation, reference information can be shared by *product data* such as a prototype, running data or design parameters. This is argued to reduce the *uncertainty regarding the innovation* as this provides a concrete proof that the technology and product are operational. Furthermore in cases with a high application fit this influence is argued to be stronger as this increases the applicability of the information. Because of the concrete proof of the technology it is argued that this *product data* acknowledges or even increases the perceived *relative advantage*. The latter statement is based on the assumption that organizations have rational buying motives and hence their adoption gives proof of the relative advantage claimed by the NTV.

#### [Knowledge & skills](#)

The *knowledge and skills* that are developed while working with the reference customer are found to be a source of information for potential adopters. Through indicators as the use of industry jargon, knowledge of the business as well as technical matters the potential adopter is able to evaluate the capabilities of the NTV. It is argued that the NTV's knowledge and skills developed while working with reference customers have a positive influence on its *perceived capabilities*.

#### [Revenues](#)

The reference customer is not only vital for the development of the NTV's innovation and knowledge & skills as previously posed, it is also an actual paying customer. This first stream of revenue is especially relevant for recently established firms as this can make the difference

between failure and continuation of the venture (Gomez-Arias & Monterroso, 2007). Therefore the mere existence of a reference customer is argued to decrease the perceived risk of failure. These findings are aggregated in a conceptual model, which is displayed in figure 2.

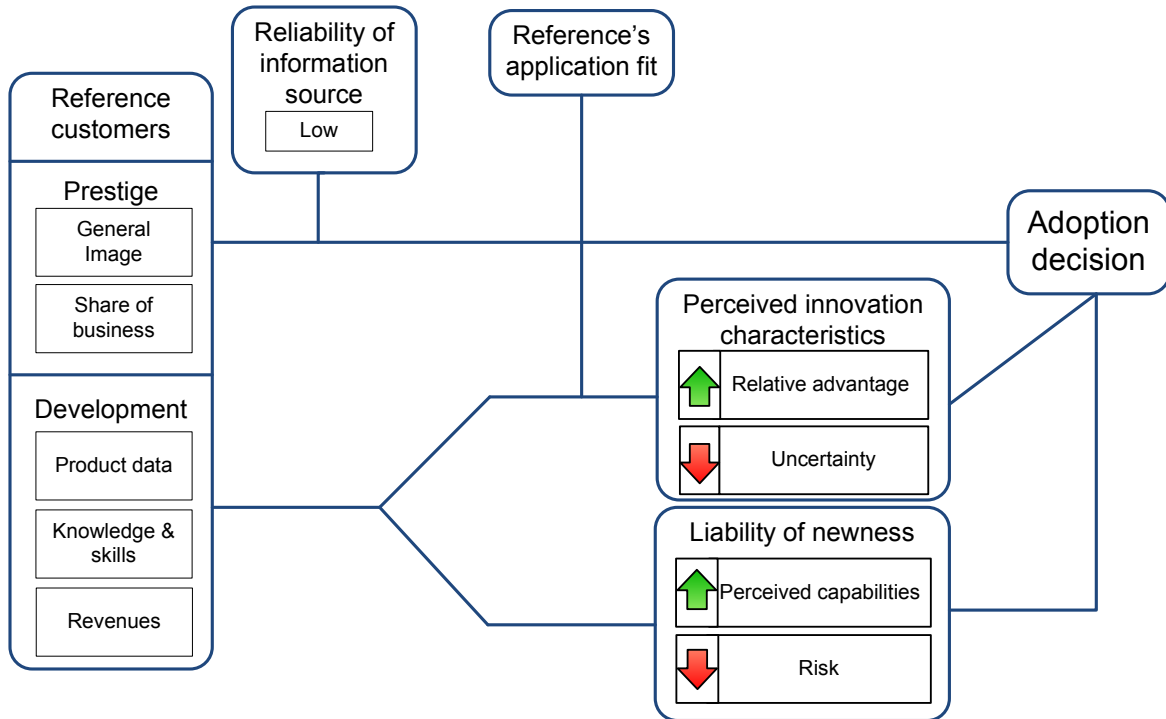


Figure 2: reference customers information model



## Opinion leaders

	<b>Concept</b>	<b>Causal condition</b>	<b>Outcome(s)</b>	
<b>Case</b>	<b>Opinion leader</b>	<b>Radicalness innovation</b>	<b>Innovation characteristics</b>	<b>Liability of newness</b>
<b>Beta</b>	Professor that refers NTV to potential adopters	High	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;"> <span>Relative advantage</span> </div> <div style="display: flex; align-items: center;"> <span>Uncertainty</span> </div> </div>	<div style="display: flex; align-items: center;"> <span>Perceived capabilities</span> </div>
<b>Gamma</b>	Professor that refers NTV to potential adopters	High	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;"> <span>Relative advantage</span> </div> <div style="display: flex; align-items: center;"> <span>Uncertainty</span> </div> </div>	<div style="display: flex; align-items: center;"> <span>Perceived capabilities</span> </div>
<b>Eta</b>	Famous football trainer that praises innovation	Low	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;"> <span>Relative advantage</span> </div> <div style="display: flex; align-items: center;"> <span>Uncertainty</span> </div> </div>	

Table 4: opinion leaders comparison table

In three of the cases an individual that can be considered to have a significant amount of influence within his social network, hence an opinion leader (Rogers, 2003), was found (see table 4). This was limited to these three cases as a relevant and significant presence of an opinion leader was found to be subject to three conditions. Firstly this individual needs to have sufficient personal credibility to be able to influence potential adopters and in this context of radical innovation such expertise is scarce. Secondly this individual needs to be part of a network in which potential adopters are present, which is less likely when it concerns an academic. Thirdly the individual has to be willing to advocate for the innovation and NTV as these may affect one's personal credibility. In two of the cases (Beta & Gamma) this opinion leader concerned a university professor who is in charge of the research group in which the innovation was developed. These individuals are members of the scientific community though their influence is not exerted on this community but in the business community. Both interviewees indicated that they were referred to potential adopters by these individuals. In the other case (Eta) it concerned a highly regarded football trainer who praised the innovation in promotion materials. This expert opinion that acknowledges the credibility of the innovation is argued to reduce uncertainty regarding the innovation and to increase the perceived relative advantage. Though these influences may be limited to tangible innovations with a high application fit as only then this acknowledgement concerns the actual innovation that potential adopters are busy evaluating. Though the opinion leader's influence is not always limited to the innovation characteristics as in two of the cases (Beta & Gamma) it was found that it also

influenced the NTVs liability of newness. This difference may be explained by the higher degree of radicalness of the innovation hence a higher complexity and uncertainty causing potential adopters to question the NTVs ability to deliver what they promise. Thus the opinion leader's acknowledgment of the NTV as a credible supplier of this radical technology increases its perceived capabilities. These findings are aggregated in a model, which is displayed in figure 3.

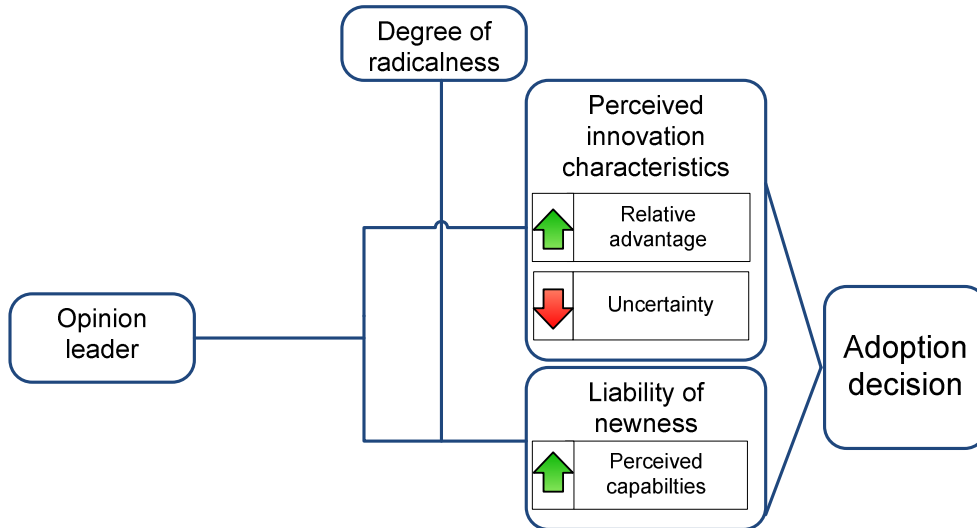


Figure 3: opinion leader information model

## Founding team

	Concepts			Causal condition	Outcome(s)	
Case	Parent organization	Track record	Networking capability	Corporate /academic	Innovation characteristics	Liability of newness
<b>Alfa</b>	Status and strength IP. Limited cooperation. Network of great value.	Excellent track record in industry	No clear mention	Corporate	<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px;">  Relative advantage         </div> <div style="border: 1px solid black; padding: 2px;">  Uncertainty         </div> </div>	<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px;">  Perceived capabilities         </div> <div style="border: 1px solid black; padding: 2px;">  Risk         </div> </div>
<b>Beta</b>	Profiled as TUE spinout, emphasized for status.	Management presented as competent TU/e Engineers	No clear mention	Academic	<div style="border: 1px solid black; padding: 2px;">  Uncertainty         </div>	<div style="border: 1px solid black; padding: 2px;">  Perceived capabilities         </div>
<b>Gamma</b>	Profiled as TUE spinout, emphasized for status. Support by equipment and expertise	Management presented as competent TU/e Engineers	Potential adopters & partners through networking at fairs & networking events	Academic	<div style="border: 1px solid black; padding: 2px;">  Uncertainty         </div>	<div style="border: 1px solid black; padding: 2px;">  Perceived capabilities         </div>
<b>Delta</b>	Some equipment given by PO. Great advantage of reputation and network	Team has excellent track record, communicated intensively outwards	Very important, customers and partners through network, business fairs & association	Corporate	<div style="border: 1px solid black; padding: 2px;">  Uncertainty         </div>	<div style="border: 1px solid black; padding: 2px;">  Perceived capabilities         </div>
<b>Epsilon</b>	Profiled as TUE spin-off, University paid for IP, free license. Cooperation with research groups and several professors	Team has excellent track record in entrepreneurship and technology, communicated outwards	Very important. To acquire partners, suppliers. Member of industry association	Academic	<div style="border: 1px solid black; padding: 2px;">  Uncertainty         </div>	<div style="border: 1px solid black; padding: 2px;">  Perceived capabilities         </div>
<b>Zeta</b>	Use of network and some support.	Company benefits a lot from track record of entrepreneur.	No clear mention	Corporate	<div style="border: 1px solid black; padding: 2px;">  Uncertainty         </div>	<div style="border: 1px solid black; padding: 2px;">  Perceived capabilities         </div>
<b>Eta</b>	Profiled as Tue spin-off for status, university paid for IP, free license	Track record of marketing director (serial entrepreneur) helped in getting funding and partners.	Being introduced is very important, find opinion leaders	Academic	<div style="border: 1px solid black; padding: 2px;">  Uncertainty         </div>	<div style="border: 1px solid black; padding: 2px;">  Perceived capabilities         </div>
<b>Theta</b>	Profiled as Tue spin-off, emphasized for status	Founder has excellent track record	Very important. To acquire partners, suppliers. Member of industry association	Academic	<div style="border: 1px solid black; padding: 2px;">  Uncertainty         </div>	<div style="border: 1px solid black; padding: 2px;">  Perceived capabilities         </div>

Table 5: founding team comparison table

In all of the cases the interviewees recognized the influence of the founding team on the adoption decision (see table 5). Though there are differences in what elements were found to be influential and the outcomes of these influences. The findings for the three elements of the founding team (parent organization, track record and networking capability) will be discussed separately.

#### Parent organization

The parent organization was recognized as influential in all of the cases, though the degree of influence and outcomes differed significantly. In all but one of the cases it was found that the general image of the parent organization was used to improve their own image. Therefore it is argued that this link decreases the uncertainty regarding the innovation as the innovation has been (partly) developed within this organization. A similar influence is found related to the perceived capabilities of the NTV though there is a clear distinction between academic –and corporate NTVs. The academic NTVs in the sample all originated at the Eindhoven University of Technology which is highly regarded for its technological capabilities in research and education. All of these cases reported utilization of their relation with the university such as the use of facilities, financial support, technical support and the use of intellectual property. Because of this it is argued that an academic parent organization increases the NTVs perceived capabilities, though this mainly entails technical capabilities as this is the *general image* of the University. The three cases that originated at a corporation reported a different utilization of the relationship with their parent organization. One of these NTVs (Delta) started because its parent organization ceased operations at its Dutch branch and thus Delta became an indirect competitor and therefore not more than some initial minor support was received. The other two cases received more support such as technical support and use of facilities, though in all three cases the *general image* of the parent organization was seen as the most important benefit. Their parent organizations are considered market and/or technology leaders and this is argued to increase the NTV's perceived capabilities though both technical as well as managerial.

#### Track record

In seven of the eight cases one or more of the members of the founding team have a significant track record, though a clear distinction can be made between experience in an academic environment and in a corporate environment. In four of these cases this experience was acquired in the industry in which the NTV is active and is thus relevant experience in managing technical projects. This is argued to increase the NTV's perceived capabilities, both technical and managerial. The three other cases entailed experience in an academic environment which is also argued to increase the NTV's perceived capabilities though merely technical. This distinction is modeled by adding a moderating variable labeled *type of parent organization*.

#### Networking capabilities

Because of the latent nature of this concept it is difficult to link it to any concrete outcomes as found in three of the cases. In the cases in which the outcomes were more concrete these entailed access to/the acquisition of potential adopters, investors, suppliers, employees and partners. The utilization of these relationships helps in gathering knowledge and skills and is therefore argued to increase the NTV's perceived capabilities. The corporate NTVs have a clear benefit compared to academic NTVs as they can utilize the network that they have built at their

parent organization. These contacts are active in the same industry as the NTV and are therefore of great value.

These findings are aggregated in a model, which is displayed in figure 4.

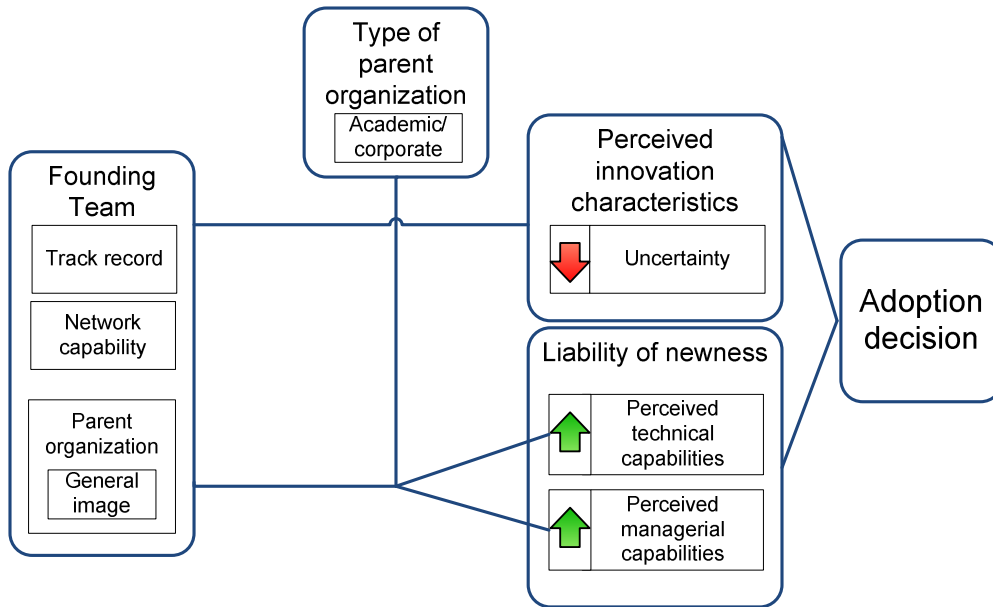


Figure 4: founding team information model

## Advisory board

	<b>Concept</b>	<b>Outcome(s)</b>
<b>Case</b>	<b>Advisory board</b>	<b>Liability of newness</b>
<b>Alfa</b>	Formal, technical and market specialists, consulted for major decisions	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Risk         </div> </div>
<b>Beta</b>	Formal, academic and business, consulted for all kinds of advice. Referring them to potential customers	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Risk         </div> </div>
<b>Gamma</b>	Formal, academic, business and entrepreneurship specialists. Help establish confidence and provide support and advice	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Risk         </div> </div>
<b>Delta</b>	Informal, former executive from parent organization consulted occasionally	<i>No concrete relevant outcomes</i>
<b>Theta</b>	Formal, academic and shareholders, financial advice. External consultant for sales & marketing	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Uncertainty         </div> </div>

Table 6: advisory board comparison table

In five of the cases the interviewees indicated the existence of an advisory board (see table 6). One of the cases' (Delta) advisory board was informal and only consulted occasionally and thus its influence could not be linked to any relevant and concrete outcomes. The other cases have a formal advisory that consisted of people with different backgrounds and expertise such as a university professor, financial specialists and industry specialists. The NTVs management consults them for a wide variety of issues as strategic advice, financial advice and technical advice. The similarity between the cases is that they consult senior and experienced individuals for advice on topics on which they believe they are not sufficiently capable of. Therewith the advisory board is involved with the decisions related to the management of the venture which increases the NTV's perceived capabilities and additionally decreases the risk of failure of the venture. These findings are aggregated in a model, which is displayed in figure 5.

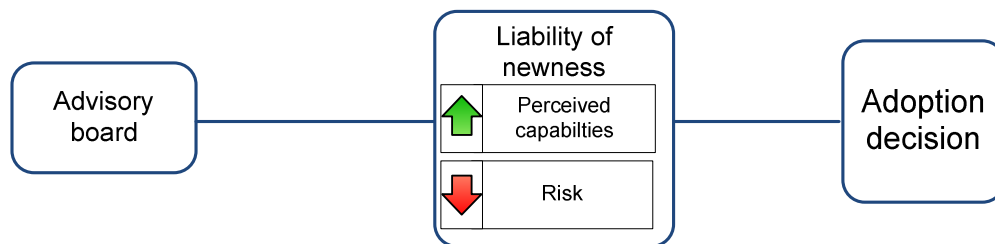


Figure 5: advisory board information model

### Partnerships

	<b>Concept</b>	<b>Outcome(s)</b>	
<b>Case</b>	<b>Partnerships</b>	<b>Innovation characteristics</b>	<b>Liability of newness</b>
<b>Alfa</b>	Selecting best partners (engineering firms, research centers, production)	Uncertainty	Perceived capabilities
<b>Beta</b>	Minor R&D partnerships	No concrete outcomes	No concrete outcomes
<b>Gamma</b>	Main partner is engineering firm, capable of construction and finance of full scale installations. Cash flow and access to larger projects.	Uncertainty	Perceived capabilities Risk
<b>Delta</b>	Partnerships (software, electronics, production) to work with the best. Perform audits.	Uncertainty	Perceived capabilities
<b>Epsilon</b>	R&D partnerships (academic and corporate) to acquire knowledge, production partner.	Uncertainty	Perceived capabilities
<b>Zeta</b>	Minor R&D partnerships,	No concrete outcomes	No concrete outcomes
<b>Eta</b>	Production partnership and development partner (football club) increased credibility, communicated outwards	Uncertainty	Perceived capabilities Risk
<b>Theta</b>	Partnership for customer support, looking for system integrator as partner	Uncertainty	Perceived capabilities

Table 7: partnerships comparison table

In all of the cases the interviewee indicated the existence of one or more partnerships (see table 7). These partnerships ranged from relatively minor R&D projects to the outsourcing of the complete production. Mainly there are two types of partnerships: R&D and production. R&D partnerships can be with parties that possess knowledge and skills the NTV lacks or with parties that lack the knowledge and skills of the NTV. From the latter the NTV benefits by acquiring new knowledge and skills and possibly revenues and hereby making technological and organizational developments (development part). These partnerships thus provide access to additional capabilities and hereby increase the NTVs perceived capabilities whilst reducing the uncertainty regarding the innovation. This influence is stronger when the partner has a good *general image* because of the quality of its capabilities. This proposition is supported by the findings of several cases in which the importance of a highly regarded partner is emphasized by the interviewee. Furthermore it was found that when a partnership yields significant revenues this reduces the perceived risk of failure. These findings are aggregated in a model, which is displayed in figure 6.

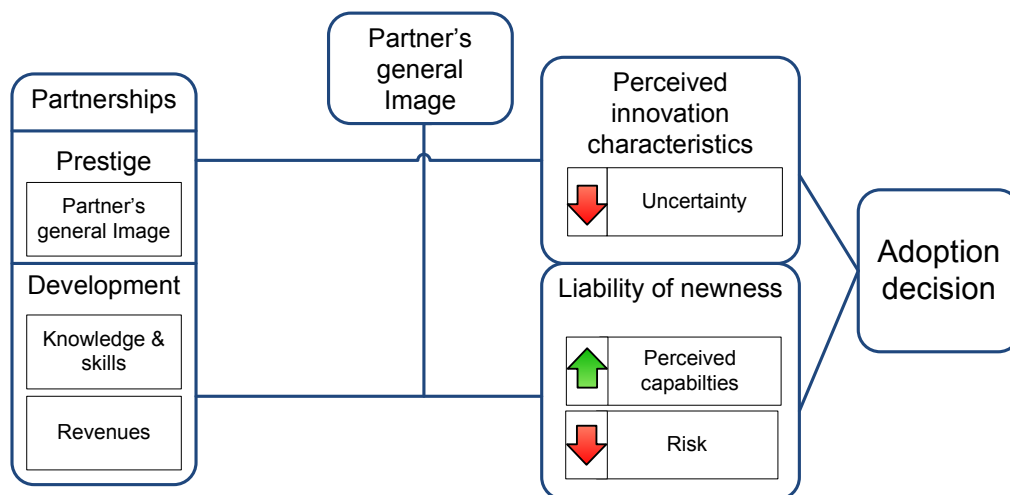


Figure 6: partnerships information model



## 5 Discussion and reflection

### 5.1 introduction

In this final chapter the findings of the cross-case analysis will be discussed and reflected upon firstly. These findings and compared to the theoretical framework thus focusing on differences and similarities in order to draw conclusions. This discussion will be followed by the final conceptual framework which is the result of the third research assignment which is:

**assignment 3:**

Integrate the findings of both assignment 1 and 2 in a conceptual framework, modeling the innovator's adoption decision.

Furthermore the managerial and theoretical implications will be discussed followed by the limitations of the findings of this study and lastly directions for further research.

### 5.2 Discussion

#### 5.2.1 General discussion

The theoretical framework was found to capture the phenomenon being researched quite accurately though it was extended and modified by the findings of the case studies to increase its accuracy. The adjustments to Roger's (2003) model were supported by the case studies. Firstly the addition of the NTV's liability of newness found strong support in the case studies. The evaluation of suppliers is a common practice in business (Weber, Current, & Benton, 1991) though of even more importance when adopting from these newly established and risky ventures. Secondly, uncertainty regarding the innovation was found to be a perceived innovation characteristic which is rather obvious in this context. Innovator customer's want to adopt radical innovations to obtain competitive advantage though this decision is characterized by significant uncertainty. Moreover little support was found for adding switching costs though this can be explained by design of this research. These costs are more clear and relevant for the adopter hence troubling the NTV's perspective resulting in weak evidence. Though, in general, the adoption decision seems to be an evaluation to objective and, mainly financial, settled criteria in line with findings of Alden, Steenkamp & Batra (1999). Thirdly the addition of information sources by drawing on information seeking theory was supported by the findings. The information sources that were added all met the requirement of sufficient theoretical and practical support. These sources are not prioritized because of the explorative nature of this research project and because of the research design, which did not include the adopter itself but the supplying party (NTVs). Lastly it was found that (potential) adopters consult a variety of sources to seek for information that can reduce their *uncertainty regarding the innovation characteristics* and the *NTV's liability of newness*.

In addition to the sources in the conceptual framework two additional sources of information (advisory board and partnerships) for which sufficient evidence and theoretical support was gathered are added to the framework. Two other information sources that were found to influence the adoption decision were not added because there was not sufficient evidence to support these. This concerns intellectual property and research grants. Intellectual property can

be argued to be influential for two reasons. Firstly, as found in case Gamma, it may decrease the perceived risk of failure as in the event of bankruptcy customers are left with the valuable IP of the technology. Secondly as found in relation to the parent organization in case Alpha a patent can be legally protected and hereby provides protection from completion. Although the latter argument may not be valid as the NTVs lack of financial resources generally does not allow for the costly process of litigation. Therefore intellectual property is not added to the conceptual framework.

Moreover research grant(s) is not added to the framework as an information source because its influence is also difficult to assess and argue. One may argue that by receiving a research grant the credibility of the innovation and NTV are acknowledged by the party that awards the grant. Though these resources may be allocated to other activities than to customer projects which may increase the NTVs capabilities in general though negatively affect its main innovation. Moreover receiving research grants is a common practice in R&D intensive SME's (Meyer, 2003) thus rather an obvious than a distinguishing feature. It might even be that the fact that an NTV 'needs' grants to operate is considered a sign of weakness. In conclusion it can be stated that there is some evidence to support this source's influence though it is too weak to draw any conclusions. Moreover complexity, trialability and observability were retained as innovation characteristics as these found to be considered relevant in the adopter's evaluation of the innovation, though with weak evidence also as a result of the NTV's perspective.

### 5.2.2 Reference customers

The value of references in business-to-business marketing is widely acknowledged in literature (Salminen & Moller, 2006) and was confirmed by the findings. Though this information was not found to be shared and utilized as commonly described in literature. Direct sharing by means of reference lists, trade journal, press releases, site visits and promotional material was hampered by confidentiality and low applicability. The first may be explained by the characteristics of the markets in which NTVs are commonly active. In these fast moving, highly competitive and expensive markets in which being the first to adopt provides an organization with a (temporary) competitive advantage (Gomez-Arias & Montermoso, 2007). By sharing information the reference customer may lose this lead in the marketplace and they are therefore found to be unwilling to do so, in other words they are not willing to advocate for the new technology and venture as it does not benefit but threatens their own business. The latter, low applicability due to a low fit between the business cases, was found in several cases and contradicts the assumption that NTVs are commonly active in homogenous niche markets (Salminen & Moller, 2006).

In conclusion reference information *may not* and *cannot* be shared by NTVs which resulted in a major modification of this part of the theoretical framework. The reference customer serves a place for making technological and organizational *developments* and is shared by means of the outcomes of these developments which are: *product data, knowledge & skills and revenues*. These are discussed separately below.

### Product data

When the case entails a tangible innovation reference information can be shared by product data which is argued to reduce the uncertainty regarding the innovation as this provides a concrete proof that technology and product are operational in line with findings of Salminen & Moller (2006) and Frambach (1993). This influence is found to be stronger with a high application fit due to the similarity between the business cases. Because of the concrete proof of the technology it is argued that this product data acknowledges or even increases the perceived relative advantage in line with findings of (Ruokolainen & Igel, 2004).

### Knowledge & skills

The *knowledge and skills* that are developed while working with the reference customer are found to influence the NTVs capabilities. NTVs have close interaction and cooperation with their customers which enables these customers to evaluate its level of competence. From the context of industrial purchasing it is found that this relation is needed to convince customers of the NTV's capabilities (Lindgreen, Antiocho, Palmer, & Heesch, 2009) thus underpinning the proposed model.

### Revenues

Reference customers are the first actual paying customers this can make the difference between failure and continuation of the venture (Gomez-Arias & Monterroso, 2007). Therefore a reference customer is argued to decrease the perceived risk of failure. This is underpinned in the industrial purchasing literature in which evaluation of a vendor's financial position is found to be a common practice (Weber, Current, & Benton, 1991).

## **5.2.3 Opinion leaders**

The influence of opinion leaders as posed was supported by the findings although only in three cases a significant and relevant influence was found. Opinions leaders are found to increase the perceived relative advantage and to reduce uncertainty regarding the innovation. Though, in contrast to the conceptual framework, their influence was not limited to the innovation. Their recognition of the credibility of the NTV is found to influence its perceived capabilities. The notion that their influence is exerted on the scientific community (Popovic & Fahrni, 2004) was not supported by the findings. Although these individuals were active in this community their influence was exerted on contacts in the industry given that potential adopters were to be found here.

## **5.2.4 Founding team**

### Parent organization

The influence of the parent organization was supported by the findings. The general image of the parent organization was found to improve the NTVs image and hereby to decrease the uncertainty regarding the innovation. Additionally the parent organization was found to influence the NTV's perceived capabilities though a notable difference was found between academic and corporate NTVs. The academic NTVs received several kinds of benefits from their parent organization, in line with the findings of Smilor et al (1990), though this is argued only to increase technical capabilities due to the general image of universities. This supports the

findings of Grandi & Grimaldi (2003) who argued that affiliation with a university can be associated with a lack of managerial competences. The corporate NTVs also received benefits from their parent organization though these were found to be different and to influence both their perceived managerial capabilities as well as their technical capabilities as the image of their parent organization concerns high capabilities on both of these aspects. These findings are supported by several authors who found that image/reputation is very important for the perceived value of an offering (Traynor & Traynor, 2004) (Lindgreen, Antioco, Palmer, & Heesch, 2009).

#### Track record

The founding team's track record is found to influence the NTVs perceived capabilities, though a difference was found between an academic and a corporate track record. The first only influences technical capabilities which is in line with the findings of Grandi & Grimaldi (2003) who argued that affiliation with a university can be associated with a lack of managerial competences. A track record in a corporate environment influences both technical and managerial capabilities which is underpinned by Ruokolainen & Igel (2004) who argue that working experience in a large multinational provides the managerial skills necessary for developing new products and managing customer projects. Therefore type of parent organization is added as a moderating variable, moderating the capabilities that the track record influences (see figure 7).

#### Networking capabilities

Networking capabilities were found to influence the NTVs perceived capabilities. Firstly because it provides the venture access to potential adopters, investors, suppliers, employees and partners in line with findings of Birley (1985). Secondly it provides access to information which can improve business (Donckels & Lambrecht, 1995) and lead to a more market oriented and focused use of (scarce) resources (Walter, Auer, & Ritter, 2006). As NTVs are likely to rely on the network that was built while active at their parent organization (Grandi & Grimaldi, 2003) a difference was found between the academic and corporate NTVs. The latter initially have more relevant contacts in the industry in which they are active and thus of greater value.

### **5.2.5 Advisory board**

The existence of an advisory board was found to influence the NTVs perceived capabilities and risk of failure due to the board's involvement in managing the venture. This is underpinned by findings of Robson & Bennett (2000) who linked external advice to positive firm performance.

### **5.2.6 Partnerships**

Partnerships were found to influence the NTVs perceived capabilities and uncertainty regarding the innovation by providing access to knowledge and skills which is underpinned by the findings of (Davies & Brush, 1997). Other findings even suggested that the growth rate and overall success of NTVs were highly dependent on the formation and utilization of partnerships in a variety of fields (Mustar, 1998).

## 5.2.7 Final conceptual framework

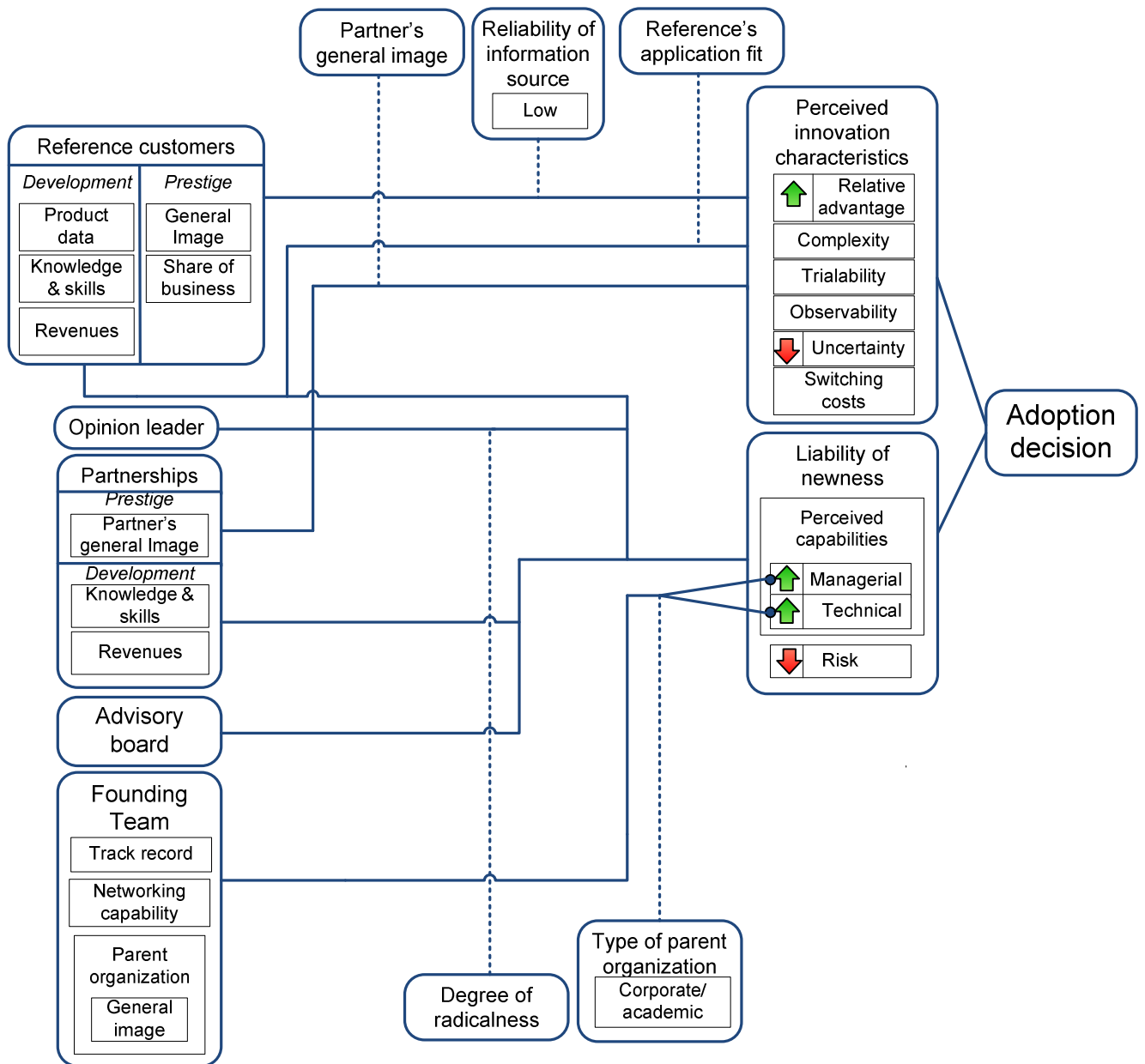


Figure 7: The conceptual framework

The final conceptual framework (see figure 7) consists of five information sources (left side) that exert an influence on the innovation characteristics and/or the NTV's liability of newness (right side) and thus can be regarded as the dependent variables. For several of the innovation -and liability of newness characteristics the direction of the influence was found and included in the model by adding arrows. These relations are moderated by 5 variables (top and bottom of framework) which are linked by dotted lines for clarity. The information sources that were included all met the requirement of sufficient theoretical and practical support. Moreover no

priority or magnitude has been assigned to the different information sources because of the explorative nature of this research project and due to the research design, which did not include the adopter itself but the supplying party (NTVs). In comparison to the theoretical framework developed in chapter 2 this model includes two additional information sources and three additional moderating variables, thus the goal of underpinning and extending the framework has been attained. All but one (compatibility) of the innovation characteristics has been retained as this characteristic was not found to be of much relevance to adopters. Firstly because radical innovations are by definition not compatible with current technologies, values and needs and secondly because innovators are the adopters trying to break existing patterns and market norms and thus compatibility is not an issue to them.

An overview of the specific influences for each of the information sources is provided in table 8.

<b>Concept</b>	<b>Influences</b>	
	<b>innovation characteristics</b>	<b>liability of newness</b>
<b>Reference customers</b>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Relative advantage         </div> <div style="display: flex; align-items: center;">  Uncertainty         </div> </div>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Risk         </div> </div>
<b>Opinion leader</b>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Relative advantage         </div> <div style="display: flex; align-items: center;">  Uncertainty         </div> </div>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> </div>
<b>Founding team</b>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center;">  Uncertainty         </div> </div>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> </div>
<b>Advisory board</b>		<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Risk         </div> </div>
<b>Partnerships</b>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center;">  Uncertainty         </div> </div>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 5px;">  Perceived capabilities         </div> <div style="display: flex; align-items: center;">  Risk         </div> </div>

Table 8: specific influences per information source

### 5.3 Managerial implications

From a managerial point of view the findings of this research project will be useful for the executives of NTV's as it provides insights in the adoption decision of their customers. Understanding the preferences and behavior of the target market is a critical component of marketing (Moore, 2006) (Banyte & Salickaite, 2008) (Hills, Hultman, & Miles, 2008). NTV executives may be better able to address specific marketing and sales challenges and herewith alter the venture's marketing- and sales strategy & tactics to increase commercial success.

Firstly the reputation and related credibility of the NTV can be enhanced by a set of decisions and actions. This credibility can be regarded as a cumulative result of features that enhance its reputation as credibility is an issue of reputation (Meldrum, 1995). In this sense the information sources can be regarded as features of the business' reputation and therefore their specific role and use in practice is discussed.

The utilization of reference information can be improved significantly though careful considerations will have to be made and negotiated with reference customers on what information can be shared without infringing information considered vital for their business operations. Subsequent adopters can be persuaded with this information by means of reference lists, trade journals and site visits. Furthermore the use of reference information can be improved by applying acquired knowledge and skills to improve business processes and products or secure these in databases such as a customer relationship management (CRM) system or other enterprise software.

The same goes for product data which can be gathered, secured and shared by different means such as a prototype, simulation model, running data and design data. This real world proof of the product being operational is very valuable for subsequent adopters. Moreover information of the streams of revenue that have been derived from reference customers can be made openly available to subsequent customers to provide insight in the venture's financial position.

Furthermore opinion leaders can be used more actively for example in promotion activities (i.e. testimonials in trade magazines, leaflets and websites) to enhance the credibility of the technology and venture. Especially when this concerns a university professor as they are commonly highly regarded for their expertise in innovation and technology.

The track record of the founding team can be communicated to customers to increase credibility focusing especially on relevant education and experience for running their specific venture. Though as this track record mainly entails technical capabilities or managerial capabilities related to the management of technological products it would be advisable for an NTV to extend their team with a marketing & sales professional. This team member is likely to increase the NTVs perceived capabilities and may even reduce the adopter's perceived risk of failure as the overall management of the NTV is improved. Furthermore the parent organization can be used as a showcase hence using this organization's image to increase the venture's image. This can be extended by communicating what support is received such as ideas, consultants, research expertise and membership of a center for technology transfer or business/industry network. The



founding team's networking capability is less visible hence more difficult to show to potential customers, though by showing the results of this concept. In example by communicating contacts and their value for the venture such as research institutions, industry networks and consultants. The advisory board can be used in a similar manner as opinion leaders by stressing their credibility and in this case their active role in managing the business with their specific expertise. Finally partnerships, their purpose and intensiveness can be communicated outwards and in doing so stressing the general image of these partners.

In general the NTV's marketing strategy should focus on stressing the innovativeness and thus strong relative advantage of their innovation and the firm's superior capabilities to guide and support a successful implementation of the technology. The adoption decision is mainly objective and thus merely a rational consideration of cost versus benefits thus the overall message should be factual and aiming to reduce the perceived risk of potential adopters.

## **5.4 Theoretical implications**

The current body of literature lacks a conceptual framework for the adoption decision of innovator customers buying from an NTV. This explorative research is to be regarded as a first effort to close this gap of knowledge. Rogers' (2003) set of innovation characteristics has been adjusted for application on radical innovations by adding uncertainty in switching costs. Furthermore the NTVs liability of newness was found to be relevant to the adoption decision whereas the extant literature focused more on the mere evaluation of the innovation characteristics. By drawing on information seeking theory the understanding of the adoption process has been extended. The sources of information that were posed to influence the adoption decision in the theoretical framework (reference customers, opinion leaders & founding team) have been underpinned by the finding of the case study. Furthermore sufficient evidence was found for an additional two sources of information (advisory board & partnerships) and underpinned by findings from literature. Additionally reference information was not found to be shared and utilized as commonly described in literature. Direct sharing by means of reference lists, trade journals, press releases, site visits and promotional material was found to be hampered by confidentiality and low applicability. The first may be explained by the characteristics of the markets in which NTVs are commonly active. In these fast moving, highly competitive and expensive markets in which being the first to adopt provides an organization with a (temporary) competitive advantage.

## **5.5 Limitations**

The findings of this research project are subject to limitations. The theoretical framework was developed by using a purposive sample as literature was either found by snowballing or by using a limited set of search terms. This may result in an absence of theories that are potentially important for this research. On the case studies other limitations apply. Eisenhardt (1989) argues for the use of multiple data collection methods such as archival sources, observations and interviews hence triangulation. The support for concepts and propositions will be stronger when based upon multiple sources of evidence. But then again this view of triangulation is



criticized from an epistemological perspective as no method of data analysis is able to produce perfect evidence (Ritchie & Lewis, 2003). The use of quantitative data can be useful for the same rationale as multiple data sources. This research dominantly relies on a single data collection method and mainly on one source which weakens the collected evidence. Furthermore the use of interviews as a source of evidence has its specific weaknesses. These weaknesses entail a bias due to a bad articulation of questions, a response bias, imperfections due to weak recall of past events and the tendency of respondents to give what the researcher wants to hear. The last limitation relates to external validity of the case studies hence whether the findings of the sample are relevant beyond the sample and context of the research (Ritchie & Lewis, 2003). Because the sample of NTVs mainly consists of organizations that originate at the same university this may limit the generalization of findings. Then again the diversity of the business models and industries in which the NTVs are active may minimize the impact of this bias. This relates to the concept of reliability which is the expected level of replication if similar studies are performed. This can be enhanced by showing the reader of the research project the procedures that have led to findings and related conclusions (Saele, 1999). This advice has been followed by including the interview protocol, coding tables and comparison tables. The final limitation concerns its validity. The internal validity, which relates to if you are investigating what you claim to be doing (Arksey & Knight, 1999), may be lower due to the perspective. The conceptual framework is developed from the perspective of the adopter whilst the case studies were performed at the supplier though because of the explorative nature of this research this is not too much of an issue. The external validity can be argued to be stronger due to the heterogeneity of the sample which makes it more representative for the general population of NTVs.

## 5.6 Directions for future research

This research project is to be considered explorative in this field of research and consequently there are many avenues for further research. The next step in underpinning the framework developed in this paper might be to involve customers of these new technology ventures to describe their perspective on the adoption decision. Additionally research efforts focusing on a single case and hereby gathering far more extensive data on adoption and diffusion may be carried out. For example by partaking in the full adoption decision process, from lead to closure, may deliver very valuable insights. This research has an explorative nature and focuses more on the explanation of phenomenon in general than on the details. Research focusing on the influence of the listed information sources in more detail may increase the understanding of these sources in this context. Such research could aim at operationalising the framework and hereby prioritizing the different information sources and the magnitude of their influence.

Although this research makes no actual distinction between the adoption of a product or a service the differences cannot be neglected. The intangibility of a service makes it difficult for organizational buyers to evaluate the purchase (Valk & Rozemeijer, 2009). Fitzsimmons et al point out that the purchase of services is more complex because it implies different risks for the buyer with regard to evaluating the vendor and the service. (Fitzsimmons, Noh, & Thies, 1998). When adopting a tangible product the level of trialability can in example be expected to be lower

whilst switching costs, can be expected to be higher consequently affecting the level of perceived uncertainty. Initially there is no focus on either of these types of innovations as the explorative nature of this research project allows for such deviations. Additionally in five of the eight organizations no clear distinction between product and service could be made. This can be explained by their tendency to be rather flexible by providing consulting services while performing R&D activities on their innovation. This flexible business model is a common theme in the entrepreneurial marketing literature (Hills, Hultman, & Miles, 2008). Future research may aim at further exploring the influence of tangibility of the innovation on the adoption decision.

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## **Appendix 1: interview protocol**

This appendix contains the interview protocol that was used for the second research assignments, the case studies. Firstly an introduction is provided that was used to inform the interviewee about the purpose of the interview and next the questions that mainly served as a guidance are presented. These questions were divided in three sections, the formation and development of the organization, the product and the early stages of commercialization. These questions were based on the results of the first research assignment but during the interviews the researcher asked additional questions that came up during the interview.

### Introduction

This interview aims at gaining insights in the commercialization of a high-tech product launched by new technology ventures. More precisely the aim is to analyze the whole process from the decision to start, the market segment(s) selection, the first customer(s) and collaboration with these etc.

### 1. Formation and development of organization

1.1 How did the venture start? (opportunity recognition, personal circumstances/motivation, role of parental organization)

1.1.1 Who are the entrepreneurs/founders? (background/past experience, experience in entrepreneurship, research and development, marketing/sales)

1.2 Can you describe the development of the organization from the start till now?

1.2.1 Development of organization, personnel, product, strategy, education.

1.2.2 What were the crucial moments, decisions and related problems that occurred during the development of the organization?

1.3 How is the venture funded? (own capital, external financing, subsidies, grants, support in non-financial sense)

### 2. The product

2.1 Can u describe the development/history of the product?

2.1.1. Did u consider multiple markets/segments or different applications for the technology?

2.1.2 Who owns the intellectual property/where was it developed?

2.1.3 What is the role of R&D? (priority, facilities, problems)

2.1.4 R&D/marketing interaction and development of this relation over time.

2.2 Are there any scientific publications of the product?

2.2.1 Is there additional support from the scientific community for your product/venture?

2.3 How and where do you source your product/knowledge? (partnerships, alliances, advisors, consultants)

### 3. Early stages of commercialization

3.1 Market(segment) selection.

3.2 Can u describe the outlines of the marketing/sales strategy? Development over time?

3.2.1 Marketing competences, development (personnel, education, problems, crucial moments)

3.3 How did you find the initial customer(s)?

3.3.1 Can u describe the decision process to collaborate with this customer?

3.4 Can u describe the relationship with this customer? (negotiations, financial, co-development, contract etcetera)

3.5 Can u describe the interaction/information sharing with this customer? (What information? By what means?)

## Appendix 2: coding tables

This appendix contains the coding tables that were used to analyze the data that was collected for the second research assignment. Table 1 contains the core categories, concepts and definitions extracted from the conceptual framework described in chapter 1, table 2 those that were extracted from an initial within case analysis.

Core category	Concept	definition	Code
Marketing activities	Opportunity recognition	Awareness of a set of customers with a particular set of unmet needs (Webb, Ireland, Hitt, Kistruck, & Tihanyi, 2011).	M-OR
	Creating value	Provides a more efficient or effective means and/or ends (Shane & Venkataraman, 2000).	M-CV
	Customer involvement/lead users	(lead) users that provide new product concept and design data (Von Hippel, 1986).	M-CI
	Knowledge stage	Stage in which a potential adopter receives first knowledge of an innovation and how it functions (Rogers, 2003).	M-KS
	Persuasion stage	Stage in which the potential adopter will form an attitude towards the innovation (Rogers, 2003).	M-PS
	Decision stage	Stage in which a potential adopter either adopts or rejects the innovation (Rogers, 2003).	M-DS
	Innovation characteristics	Positive: Relative advantage	Perceiving the innovation as advantageous (Rogers, 2003).
Neutral: Compatibility, trialability & observability		Being consistent with the existing values, past experiences and needs of potential adopters (Rogers, 2003). The extent to which the innovation may be tried on a limited basis (Rogers, 2003). The degree to which the results of an innovation are visible to others (Rogers, 2003).	I-CTO
Negative: Complexity, switching costs, uncertainty		Perceiving the innovation as difficult to understand and use (Rogers, 2003). Assets invested due to prior purchases, that are not compatible with the new technology (Heide & Weiss, 1995). The perception of being unable to	I-CSU

		accurately predict or completely understand some aspect of the technological environment (Milliken, 1987).	
<b>Liability of newness</b>	Perceived capabilities	Perceiving the organization to be capable of delivering what is promised	L-PC
	Risk	Certainty of the future existence of the NTV and its innovation (Zacharakis, Meyer, & DeCastro, 1999).	L-R
<b>Information sources</b>	Reference customer	The initial customers that have engaged in collaborative practices for the development of the innovation and/or business processes (Gomez-Arias & Montermoso, 2007).	S-RC
	Opinion leaders	Individuals that have a significant amount of influence within their social network (Rogers, 2003).	S-OL
	Reliability of information	The level of independence, quality and detail of the information	S-RE
	Parent organization	The organization/research institute where the venture originates (Oakey, 1995).	S-PO
	Entrepreneur's track record/professional history	Entrepreneur's previous professional experience and success (Martens, Jennings, & Jennings, 2007).	S-ET
	Networking capabilities	Abilities to develop and utilize inter-organizational relationships to gain access to various resources held by other actors (Walter, Auer, & Ritter, 2006).	S-NC
<b>Outcomes</b>	Risk/uncertainty reduction	Reduced chances of problems such as further costs, interruptions to supply continuity, unexpected side-effects or quality deficiencies (Meldrum, 1995).	O-RU
	Increased credibility of the technology	Increase the adopter's belief that it will live up to the performance promised (Meldrum, 1995).	O-IC
	New potential adopters	Increased amount of potential adopters entering the knowledge stage	O-NP

Table 1: core categories, concepts and definitions derived from the conceptual framework

<b>Core category</b>	<b>Concept</b>	<b>Definition</b>	<b>Code</b>
<b>Liability of newness</b>	Advisory Board	A group of individuals who've been selected to offer expert advice to the board of directors	L-AB
<b>Information sources</b>	R&D Partnerships	Collaboration between independent companies through formal agreements devoted to increasing scientific or technical knowledge and the application of that knowledge to the creation of new and improved products and processes (Hagedoorn, 2002).	S-PT
	Research grants	Financial stimulus to perform research and development activities.	S-RG
<b>Marketing/sales strategy</b>	Flexibility	The need for products to continually evolve with changes in the external market and technology evolution (Park, 2005).	MS-F
	Stage-gate	Dividing the innovation process into a predetermined set of stages (Cooper, 1990).	MS-S
	Outsourcing	Any good or service that an organization procures from outside firms (Gilley & Rasheed, 2000).	MS-O

Table 2: core categories, concepts and definitions derived from the initial within case analysis

### Appendix 3: chase characteristics

	(in)tangible innovation	Corporate/academic	FTE	Founding year	IP at start	Support Parent 1)	Technical competence 2)	Management competence 2)	Entrepreneurship competence 2)	Outsourcing R&D	Outsourcing production	Radicalness of innovation 3)	Market	Competiveness market 4)
A	Tangible	Corporate	40	2001	Y	High	High	High	Low	Y	Y	High	Semiconductor	Med
B	Tangible	Academic	7	2009	Y	Med	High	Low	Low	N	N	High	Pharmaceutical	Low
C	Intangible	Academic	4	2009	N	High	High	Low	Low	Y	Y	High	Chemical	Low
D	Tangible	Corporate	6	2008	N	Low	High	High	Low	Y	Y	Med	Medical equipment	Med
E	Tangible	Academic	3	2009	Y	High	High	High	Med	N	N	High	Conductive inks	Med
F	Intangible	Corporate	3	2010	N	Med	High	High	Low	N	N	Med	Semiconductor	Low
G	Tangible	Academic	3	2010	Y	Med	Med	Med	High	N	Y	Low	Sports equipment	Low
H	Intangible	Academic	12	2007	N	Med	High	High	Low	N	N	High	Video content analysis	Low

- 1) Support: Network of potential customers, partners, IP, financial support, use of facilities. (in)formal advice etc.
- 2) High competence is defined as graduate in discipline or >5 years professional experience in discipline.
- 3) incorporates a substantially new core technology and (2) provides substantially higher customer benefits (Chandy & Tellis, 1998).
- 4) To be able to determine if NTV operates in niche market. Low: none, medium: some (1-5 competitors), high:>5.